NASA TECHNICAL MEMORANDUM NASA TM-76533

NASA-TM-76533 19810014056

Annoyance Caused by Light Aircraft Noise

Translation of "Stoerwirkungen durch den Laerm der Kleinaviatik". Institut fur Praxisorientierte Sozialforschung, Zhurich, unter Mitwirkung der Eidg. Materialpurefungsanstalt, Duebendorf, Switzerland Report, June 1980, pp. 1-132

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON D.C. 20546 MARCH 1981

STANDARD TITLE PAGE

1. Report No. NASA TM-76533	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Annoyance Caused by Light Aircraft Noise		5. Report Date MARCH 1981
		6. Performing Organization Code
7. Author(s) Anonymous		8. Performing Organization Report No.
		10. Work Unit No.
9. Performing Organization Name and Address SCITRAN Box 5456 Santa Barbara, CA 93108		11. Contract or Grant No. NASw- 3198
		13. Type of Report and Period Covered Translation
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D.C. 20546		14. Sponsoring Agency Code

15. Supplementary Notes

Translation of "Stoerwirkungen durch den Laerm der Kleinaviatik". Institut fur Praxisorientierte Sozialforschung, Zhurich, unter Mitwirkung der Eidg. Materialpurefungsanstalt, Duebendorf, Switzerland Report, June 1980, pp. 1-132

16. Abstract

This study deals with disturbances caused by the noise of general aviation. The correlation between objective and noise stresses and subjectively perceived disturbance is studied. The study was limited to a group of selected airports. Noise levels calculated for these airports are given.

17. Key Words (Selected by Author(s))	18. Distribution Statement Unclassified - Unlimited

19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 130	22. Price

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SUMMARY

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Goals and execution of the study

This study deals with the disturbances caused by the noise of general aviation. To be studied and reported was the correlation between the objective noise stresses and subjectively perceived disturbance. Also required was a scientific framework for the "Commission on the Evaluation of Noise Emission Limits" to use in determining limit values for noise stress for general aviation.

The contract given to our institute comprehended the preparation and execution of the necessary socio-psychological sampling as well as their evaluation, in connection with data concerning actual noise stresses. The calculations of noise necessary for this, together with measurements, were carried out by representatives of the Federal Office for Environmental Protection (BUS), the Federal Office for Civil Aviation (BZL) and the Federal Office for Material Testing (EMPA). The combined evaluation of this interview and noise data was carried out in the computer center of the University of Zurich.

The study was limited to a group of selected airports. In this selection, attention was paid to various areas of the country, various development structures (urban and rural) as well as airports with high and low traffic levels. Using these criteria, and after careful examination, the selection of the following airports was made: Bern-Belp, Birrfeld, Buttwil, Gruyeres, La Chaux-de-Fonds and Lugano-Agno. The topographical structure and the developmental geography of these six airport areas can be seen in the maps in Appendix I. In addition, the noise levels calculated for these airports are given.

*Numbers in margin indicate pagination of foreign text.

In each of the six areas, there were about 200 households selected (in Lugano 400), so that the samples were evenly distributed in the various (previously calculated) levels of noise stress. In each of these households, one person was interviewed /4 on a random principle. The interviews were carried out in late summer of 1979 and a total of 1430 interviews were completed.

The noise value assigned to each of the households sampled is based on a noise calculation model and it comprehended two different noise standard values: On one hand, the mean noise level maximum ($\bar{L}_{A\ max}$), on the other hand the mean level (L_{eq}) as a measure of the average noise intensity. The values calculated were checked by means of spot monitoring measurements. At this time, environmental noise was additionally measured (excluding flight noise) and this figure was assigned to the household.

The most important results of the study

a) Flight noise in the social and ecological context

The results of the interviews were intended to serve--corresponding to the broadly staged thematic of the study--for assigning a level of importance to the noise of general aviation in the inclusive framework of the total noise or environmental situation. The study showed that in the areas examined it was indeed true that the noise of small aircraft was perceived as being the second most important disadvantage of the residential area, after street noise, but that the disturbance of well-being caused by this noise from general aviation could hardly be considered to be massive.

Only about 58% of those interviewed identified aircraft voluntarily as being the source of noise they perceived from their residences. This segment seems to be relatively small in view of the fact that these people lived within only a few kilometers from the airports. (By comparison: 73% named noise from street traffic, 19% named noise from agricultural vehicles and machines and 15%

that of railroad traffic). Among those interviewees who perceived aircraft noise at all, about one-fourth felt that they were not disturbed by this noise at all. A further third named stress levels which would have to be interpreted as being very slightly disturbing. Extreme disturbance was perceived by only about 6% of all those who perceived flight noise at all.

With respect to the putative cumulative disturbing effect in the case of noise immissions, both in residences as well as in work or recreation locations, these noise effects were also considered in the interviews. Here it was shown that exactly two-thirds of those interviewed, having work locations outside the home, were subjected (in their opinion) to higher noise levels or equivalent noise levels there, in comparison to noise levels at home. Aircraft as a cause of this noise was perceived to have a rank of no higher than five and thus aircraft noise had only a subordinate significance for noise stress at the work location (the first place here was also the noise caused by street traffic). A similar picture arises for the disturbance caused by the noise of aircraft in the case of recreation time: About one in 20 interviewees indicated that they perceived noise caused by aircraft as being as loud as, or louder than, what they experienced at home when they were in places where they enjoyed recreation in summer during fine weather.

Of those interviewees who perceived airplanes as a source of noise, 10% made no differentiation among types of aircraft. Those who did differentiate named most frequently (50%) single-motor sport aircraft followed by two motor sport aircraft. Third and fourth place were taken by two aircraft categories describing aircraft which never used the nearby airports at all, namely military aircraft and airlines (26%). In the next ranks, with segments of 11-21% followed freight aircraft, small commuter aircraft, small jets and helicopters. The analysis showed that the disturbance caused by single engine sport aircraft--in terms of the disturbance caused by their noise--has a dominating role both quantitatively and qualitatively.

The daily number of aircraft flying overhead comes to 13 machines--in the mean of the responses of interviewees who perceived aircraft noise. High frequencies were named only by very /6 few interviewees: Only one in 20 spoke of more than 50 and only one in 50 spoke of more than 100 flights per day. The distance at which the aircraft flew by the residential area was given by the interviewees as being 400 m on the mean. The analysis showed as expected that the subjective disturbance caused by aircraft noise increased with the number of daily flights and the smaller the perceived distance of these aircraft flights from the residence.

The disturbance caused by flight noise concentrates very strongly on certain times of the year, certain days of the week and times of the day. Thus, about 85% of those considering themselves to be disturbed by aircraft noise name summer as that time of year in which they are most disturbed. Only about 9% on the contrary feel that this is independent of season. It is just as noteworthy that there is a strong concentration of disturbance on the weekends: 59% of the responses fall on Saturday and/or Sunday for this being the most disturbed day; by comparison, there are 21% who feel that all days of the week are equally disturbed. In terms of time of day, there is a concentration of responses on the afternoon hours with a peak between 1400 and 1500 hours.

Overall, the responses of the interviewees concerning the time of the disturbance caused by flight noise reflect with remarkable accuracy the actual operating hours of the airports being considered--insofar as these hours are known. The times with high flight frequencies are indeed during those periods (times of day, days of the week, times of the year) when the population has a large amount of free time to spend out-of-doors and in which--insofar as weekends and vacations are concerned--there is a pronounced propensity to want peace and quiet.

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b) <u>Objective noise stresses and subjective disturbance caused by flight noise</u>

To measure the subjective disturbance caused by the noise of small aircraft, two separate scale types were used:

. the scalometer and

. a combined scale, comprehending various components of disturbance.

The scalometer was adopted unchanged from earlier noise studies; it is based on a self-assigned value (in stages from 0 to 10) on how the interviewee perceives the disturbance. In contrast, the combined scale of disturbance uses a summary (addition) of 11 individually perceived aspects of the concrete effect of flight noise on perception, behavior modes, opinion or evaluation of the interviewees, whereby the individual components all are given the same weight.

In order to confirm that one only deal with disturbances caused by small aircraft actually taking off from the nearby airports and not with foreign influences (military aircraft, etc.), a corrective factor was applied--as it was for other calculations as well. For this purpose, all answers from those who felt themselves to be most disturbed by military aircraft, large airliners and/or helicopters were excluded. Also excluded were those who said that they were disturbed by planes not coming from the nearby airport as well as those who were sport pilots themselves or who had regular contact in their business (or privately) with the airport or with persons working there. This selection reduced the size of the sample from 1430 to 1013 interviewees. This also guaranteed that only the responses of those who really did experience disturbance from the flight noise associated with the nearby airport actually were dealt with in the evaluation.

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Furthermore, on this purified sample, for both disturbance scales there were large quantities on the low end of the scale and small quantities on the high end of the scale. Thus, on the scalometer, about one-third of the responses fell on the value 0 (equals "does not disturb at all") and one-fifth each on steps 1 and 2 (very slight subjective disturbance, and only about one-fourth on scale values 3-8; on the highest scale values 9 and 10 (equaling "disturbs unbearably") there were only 3% of the responses.

In the combined scale of disturbance the concentration on the lower scale values is even more pronounced: Almost one-third of the responses fall on value 0 (equals "all 11 of the disturbance components not named at all"); the responses falling on steps 1 and 2 come to about 17% combined. Values of 3 and more achieved correspondingly only about one-fifth of all those questioned in the purified sample.

With respect to the calculation of response curves as was planned for further evaluation, threshold values had to be established for the sake of being able to reduce the 10 or 11 value scale to two pronounced values each*.

For the scalometer, the threshold value was taken unchanged from earlier noise studies, namely the value 4 for a "mean to strong disturbance" and the value 7 for a "strong disturbance". The threshold values for the combined disturbance scale were so selected that by regressional analysis they could be seen to be equivalent to the threshold values for the scalometer. This came to a value of 3 for a "mean to strong disturbance" and level 5 for "strong disturbance".

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For a noise standard, in addition to the mean level L_{eq} and

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*Such response segment curves have proven to be the most appropriate method for representing correlations between noise and disturbance units. For each noise stress level measured in dB (A), they show the percentual segment of interviewees who reach the selected threshold value for the particular disturbance scale selected. Depending on the threshold value, the curves show the corresponding segment of the samples with "mean to strong disturbance" and "strong disturbance" caused by the noise.

the mean noise level maximum $\bar{L}_{a\ max}$, an additional newly developed combined measure FL was used which was calculated according to the formula $FL = L_{eq} + \bar{L}_{A\ max} - 60$.

By the combination of the three noise standards (L_{eq}, $\bar{L}_{A\ max}$, FL), with the two disturbance scales (scalometer, combined disturbance scale) with two each threshold values (mean to strong disturbance and strong disturbance), there were derived a total of 12 different curves (these curves are given on pages 65 to 76 of this report). The basic variation of the curves is relatively similar for all combinations: A flat or slightly climbing segment in the lowest dB (A) range follows--with L_{eq} for example from about 45 dB (A)--a first significant increase up to a plateau which interrupts the climbing branch of the curve in the range of the mean loudness (for L_{eq} about between 50 and 55 dB (A). Finally, there follows a second range of strong increase, whereafter the curve reaches its maximum. The last curve section is characterized by a tendency to decrease.

The correlation between noise and disturbance measures was not studied for the totality of the interviewees but only for partial groups of special interest. Thus, the following notable relationships were seen:

- the milieu of environmental noise influences the relationship between flight noise and disturbance caused by flight noise less in a quantitative sense than in a qualitative sense (that is, it has an effect on the nature of this correlation itself);
- this influence of noise--pre-stressing becomes even larger if one does not limit consideration to the objectively measured environmental noise but considers also the subjective disturbance effect caused by this noise. It is remarkable here that flight noise is most often perceived as disturbing to those persons who already are exposed to other noises and who interpret the disturbing environmental noise as the sum of several noise sources;
- the relationship between flight noise and the disturbance caused by this noise is especially strong if one is exposed to

flight noise not only at home but also at the work place and at the locations where one spends free time.

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Conclusions to be drawn

The noise of small aircraft is generally not perceived as being the dominant disturbance; massive disturbance symptoms (such as in the arrival or departure corridors of large airports, or along heavily traveled airways) thus are not to be detected. On the contrary, the spatial distribution of the noise of general aviation is very pronounced: It belongs to the characteristics of this noise that it is encountered almost everywhere and indeed even in otherwise totally quiet areas.

In connection with the occurrence of noise in different times of day, the noise of general aviation differs significantly from other types of noise: With certain exceptions (for instance, emergency flights) it does not occur at night; thus the pronounced concentration at certain days and times of day is especially noticable. For a significant group of interviewees, these times are exactly those in which an increased desire for rest and peace is detectable for the population segment affected.

This spatial and temporal situation of flight noise from general aviation leads to the hypothesis that some characteristics not included in this study, such as operating times, location of flight paths (or their observance by pilots) as well as the types of aircraft using the airports (noise properties) are just as important for the causation of disturbance as the noise stresses expressable in decibels. (In this connection, it is possible that general aviation is responsible for a larger than proportional contribution to the observable reduction of noise-free areas in industrial countries).

The remarks already made indicate that the expectations of the population in a certain residential area in terms of environmental quality play a corresponding role in the question of whether flight noise from general aviation is perceived as being disturbing. This circumstance could also explain why the correlations between noise and disturbance values are different at the different locations studied. The correlation coefficients are namely especially high where the pre-stressing of the noise environment is already high from other factors, that is in urban or industrial/commercially developed areas such as La Chaux-de-Fonds and (even more markedly) in Birrfeld and Bern-Belp. /11

If one ranks the study areas by the strength of the relationship between noise and disturbance values, it is seen that the ranking largely follows the ranking of the airports in terms of flight activity. After the general pre-stressing of the noise environment, it appears that the density of flight traffic is the next factor in importance in determining the connection between noise level and the disturbance caused by the noise.

These results indicate that the noise of general aviation is only systematically perceived as being disturbing where certain boundary conditions are present. Among these boundary conditions are the pre-stressing of the environment by noise in general, traffic density in the airport as well as the general attitude of expectation of the population towards their residential area. Only if these conditions are fulfilled to a certain minimum (cf. for example, the concept of "critical mass"), does the disturbance arising from aviation cease to be a purely individual, private problem and begin to be a social phenomenon. Only then does there arise a social, community-supported interpretation of this noisiness or a definition of that which is perceived as disturbance.

The fact that the previously mentioned preconditions influence the correlation between flight noise and disturbance caused by flight noise, qualitatively as well as quantitatively, is shown also by the fact that no single disturbance value or noise level can be designated as the indisputable best. Depending on the area--

and that means: depending on the constellation of preconditions--there arise namely the best correlation values for various combinations of noise and disturbance values.

It is not possible to answer the question of whether or not the effect factors mentioned are supplemented by the cultural factor of language (even in the sense of regional culture) in the context of the present study. It is certain that the cultural milieu /12 influences the kind and method of the arising and the severity of the social definition of noise and disturbance arising from noise; but unequivocal differences between regions are not ascertainable.

In summary, it can be concluded that the transformation of noise into a subjective disturbance in the case of small aircraft can only be systematically followed and prognosticated to a significant degree if certain conditions are fulfilled. At the same time, it can be determined that overall the connection between noise and the disturbance caused by the noise of general aviation is relatively small but when the previously mentioned pre-conditions occur cumulatively--the statistically significant relationship reaches a value of such magnitude where a comparison with other kinds of noise is completely possible. Very little can be concluded from the present study concerning the varieties and means that the various factors have of being qualitatively and quantitavely effective. A more accurate clarification would have been beyond the context of this study; it could only be carried out with the aid of further evaluation work--especially with a more intensive consideration of airport characteristics.

1. GOALS AND CONTRACT /13

The object of the present study is to consider the disturbance effect caused by the noise of general aviation. The study is to serve, in the words of the goal, "to report the relationships between the objectively measurable noise stresses and the subjectively perceived disturbances in the vicinity of representatively selected airports (regional airports and flying fields)". Furthermore, the study is to "furnish materials to the federal authorities and the Commission for the Evaluation of Noise Immission Limits for the setting of noise zones near regional airports and general immission limits for airports devoted to general aviation". (Quotation from the text of the contract).

The contract granted to our institute covered correspondingly the preparation, execution and evaluation of the necessary socio-psychological canvassing in the vicinity of the selected airports.

The necessary noise measurements were carried out by members of the coordinations group which was composed by representatives of the Federal Office for Environmental Protection (BUS), the Federal Office for Civil Aviation (BZL) and the Federal Office for Material Testing (EMPA).

To facilitate the greatest possible comparability, every attempt is to be made to use the materials of the published noise studies in terms of the questionnaire contents and evaluation methods. Specifically excluded was a basic methodological discussion of the evaluation process used.

2. CONCEPT AND EXECUTION OF THE STUDY /14

The total structure of the study was set up to deal simultaneously with two levels of study data: Sociological information on the one hand, by means of questioning, and acoustic data for noise measurement on the other hand. The junction of the two bodies of data, that is the reporting of the relationships between social and physical parameters, formed the central task of the data evaluation.

2.1. Canvassing method

There were essentially two methods available for the comprehension of data on the socio-psychological part of the study: The options of a written or of a verbal questionnaire. The advantages and disadvantages of each had to be weighed.

Written, postal questionnaires are cheaper: in the given budgetary context, a larger sample could be taken with a mailed questionnaire than with a verbal canvas. But this procedure does not permit a monitoring of the interview situation in comparison with a verbal canvas (for example, monitoring of just who actually fills out the questionnaire and avoidance of foreign influences during the answering) and it does not permit any questions to receive spontaneous answers. Written questionnaires also require that the postal addresses of the respondents be known; in contrast, other sampling methods are possible with a verbal personal interview method. It was this consideration which had special weight in the present project.

A method using personal oral interviews was settled on after clarifications made it apparent that it was necessary to have the minimum sufficient sample size for qualitatively reliable realization of the required evaluations even in the selection of the comprehensive oral interviewing.

2.2. Questionnaire

By means of non-scientific evaluations and especially as the result of visits to the various airport areas, we came to the conclusion that it would not be possible to consider the noise caused by general aviation as a dominant disturbance when compared with the noise from transport airliners or the noise of heavily trafficed roads or railroads. Therefore, a questionnaire which was limited exclusively to general aviation or to the disturbances caused by general aviation seemed to us to be insufficient. It seemed much more probable to us that the general noise milieu would be a variable basis for the subjective perception and evaluation of the noise caused by small aircraft. This consideration was the cause for a thematically relatively comprehensive treatment of the study context. Further, in the construction of the questionnaire, every attempt was made to use questions and question formulations as unchanged as possible from earlier noise studies for the sake of achieving the greatest possible comparability.

A first evaluation furnished the following theme areas which were to be dealt with in the questionnaires:

(1) Evaluation of the individual's residence situation and the quality of the immediate vicinity in terms of environmental degradation and noise.

(2) Detection of concrete environmental degradations and noise immissions of various types.

(3) Evaluation of these degradations and immissions.

(4) Specially concerning flight noise: Special characteristics of the noise sources, temporal and spatial localization of the noise sources, etc.

(5) Residential and recreational behavior: Noise immissions at these locations.

(6) Specific reactions with respect to the protection of the residential area against noise immissions.

(7) Knowledge of the airport and contacts with airport personnel as well as with general aviation overall.

(8) Socio-demographic background variables. /16

After a precision enhancement and purification of this catalog, the individual study values were translated into interview questions. The thematic sequence of the interview was selected in such a way that there was a gradual movement from general questions (living, environment) to special aspects (above all flight noise). The final form of the questionnaire is given in Appendix II.

2.3. Sample Concept

2.3.1. Selection of the airports

For research economical reasons, it was clear from the beginning that only a limited number of airports could be included in the study. Based on an initial selection which was undertaken by the BZL with consideration of various flight technical and operational aspects, there was derived a group of 10 airports.

The definitive selection was carried out paying attention to the following conditions and criteria:

- all regions of the country (language areas) were to be represented;
- the regions included were to represent both rural and urban settlement structures;
- both regional airports (with concessions) and flying fields (without concessions) were to be considered, and
- insofar as possible, the whole range of traffic patterns was to be considered (expressed by the number of flight events).

Using these criteria and after a detailed consideration of the areas in question, the final selection was made of the following 6 airports: Bern-Belp; La Chaux-de-Fonds; Birrfeld, Buttwil, Gruyeres and Lugano-Agno. These airports were used for the main questioning. The distribution of these airports in terms of the most important selection criteria is given in Table 1. Since flight noise maps (curves of equal levels of L_{eq}) were only available at this early date for the airport at Grenchen, this was selected as an additional spot for pre-testing. /17

The sample size for the German and French speaking areas was set at 200 interviews each approximately, while about 400 interviews were assigned to Lugano-Agno. This over-weighting was to guarantee that all desired special evaluations would be possible to carry out in the Italian speaking study area as well.

2.3.2. Selection of target persons

LANGUAGE REGION	Number of inhabitants 1977			TOTAL
	to 25,000	25,000 - 50,000	above 50,000	
German Swiss	-	Buttwil	Bern-Belp Birrfeld	3
French Swiss	La Chaux-de-Fonds Gruyères	-	-	3
Italian Swiss	-	Lugano-Agno	-	
Total	2	2	2	6

Within the individual study areas, it was necessary to select the persons to be interviewed in such a way that the greatest possible number of noise-exposure situations actually occurring in reality (insofar as they are connected with general aviation) would be represented. Thus, a representative sample*, in the normal sense of the word, was not attempted.

One important perspective in the selection of the sample method consisted in the fact that while the target persons were being selected, there could be no information released about the planned questioning. Because of latent or already existent disagreements over the airports concerned, it had to be assumed that the survey itself would easily become a part of such conflicts

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*That is, a sample which represents a small but "standardized" model of a basic unity in which the combination of socio-demographic characteristics and their quantitative distribution correspond to those of the entire population.

itself; such an event would have caused a systematic distortion of answers (negative pre-conceptions, charges of manipulation of public opinion or "bias" in the study, etc.). For the same reasons, the necessary acoustic measurements in the interview areas were delayed until after all of the interviews had been completed.

Because of the requirements already described, we decided on a multi-stage area sampling for the identification of target households, while the selection of the person inside each household to be questioned was made by chance. With this procedure, it was possible to guarantee that the households and persons questioned were subjected to the same levels of noise on the various noise stress rankings, and that they were distributed among urban and rural settlement patterns as well as among relatively closed and relatively open residential forms (apartment/house with garden). The distribution in terms of flight noise and settlement pattern was carried out systematically while the residential form was selected by chance.

The starting point for the determination of the target household was formed by the noise-stress map available for each airport. The intersections of two straight lines extending from the center of the runways, with the L_{eq} curves for 60, 55, 50, 45 and 40 dB as well as a supposed 35 dB curve, formed the starting points for the 12 search routes. These ran parallel to the L_{eq} curves; con- /19
sidered for the sample were also the first 17 households on this route. In the case of large multi-family dwellings, only one household was selected per story so that an over-weighting of this dwelling form would be avoided. In the selection of apartments, the various situations of these locations within the building was considered.

This method furnished for all airports an even distribution of the 200 interviews (or 400) along the 12 search routes and thus on the various noise levels. The household sample arising in this way was bundled in an optimal way which was not only favorable for the interviewing, but also for the subsequent acoustic monitoring and environmental measurement in terms of cost-efficiency.

Within the selected households, the target person to be interviewed was to be selected by the interviewer according to a prescribed random system; the lower age limit of the persons to be interviewed was 16 years of age.

2.4. History of the study

2.4.1. Pretest and revision of the questionnaire

After the necessary conceptual preliminary work (sample process, questionnaire design) in early summer 1979, a pretest was carried out in the area around the airport at Grenchen. In addition to the checking of the questionnaire, this pretest had the purpose of checking the usability of the sampling concept selected. Although the number of interviews was limited to 50, an entire sampling group of 200 addresses was reported as would be necessary in the main test. The experience gained by this event made it possible to work out an exact procedure to formulate the search process in the actual sampling while remaining within the general selection rules.

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The questionnaire was tested and modified where necessary in terms of interview duration, understandability of the questions and answer formulations, as well as consistency of the individual interview (sequence of questions, discontinuities, filter questions). For questions in which the answers were very dissimilar in terms of the prescribed answer categories, the answers offered for selection were either adapted or expanded. Where areas were skipped entirely for the pretest, these were introduced for the main test. Individual questions, for which a minimal distribution of answers could not be attained, were eliminated.

The pre-test showed that the respondents, in the overwhelming majority, reacted positively both to the general thematic as well as to the questionnaire itself. From the Questionnaire which had been worked over and subjected to a final use test, French and Italian versions were created. All three editions of the questionnaire were reviewed and approved by the BUS.

2.4.2 Determination of the target addresses

When the calculated noise curves were available for the six study areas selected for the main test, it was possible to define the target household by means of the selected procedures. As had been expected, it was not possible to complete the planned contingent in the loudest of the noise zones, although in these zones all households were included in the test (total canvassing). A rule was utilized for these areas, according to which the shortage of sampled houses was to be compensated in the next-quieter noise zone. As Table 2 shows, this was most pronounced in the very rural area around the airport at Buttwil. In this case, it was only first possible to attain a full complement of households for the 45 dB zone. /21

The target addresses were given to the responsible institute together with the main questionnaire in two forms:

1. On a map section (land map 1:25,000 and/or city maps), every house was marked in which there were one or more target households, together with the corresponding interview number(s).

2. In a list form, the postal address, or an exact description of the location was given for every target household, together with the family name.

Airport	Leq- Curves						TOTAL
	60 dB	55 dB	50 dB	45 dB	40 dB	<40 dB	
Bern-Belp	34	34	34	34	34	34	204
Birrfeld	13	55	34	34	34	34	204
Buttwil	5	6	13	100	46	34	204
Gruyères	22	28	52	34	34	34	204
La Chaux-de-Fonds	34	34	34	34	34	34	204
Lugano-Agno	35	101	68	68	68	68	408
Total	143	256	235	304	250	238	1428

Table 2: Number of target addresses, by canvassing areas and airport noise zones.

2.4.3 <u>The actual canvassing</u>

The canvas was carried out in late summer 1979 in all six study areas by the polling institute PUBLITEST AG. The interviewers employed were trained concerning the qeustionnaire and with the rules for the determination of the person to be interviewed within the target household, at special instruction meetings led by a project worker from IPSO. Where the target household could not be contacted in spite of repeated attempts, or where an interview was refused, or could not be carried out /22 because of other reasons (sickness, language, etc.), a substitute household was selected. In multi-family dwellings, this was the adjacent apartment, while in the case of single family dwellings, the next house was selected. In those noise zones where total canvassing was to be carried out, and where as a result no substitute households were present, it was necessary in each case to interview an additional person in the next household, in which one person was already to be interviewed. In this way, it was possible to avoid a further reduction of the number of interviews in these zones.

The segment of substitute households or persons selected in this was, as a proportion of the total of the interviews carried out, lowest in La Chaux-de-Fonds, with 8%. It was highest in Lugano-Arno, with 31%. This latter number is attributable to the fact that the Tessina interviewing area contains a large proportion of dwellings which are second homes, and vacation cottages occupied only intermittently.

To guarantee interview quality, the first interview carried out by each canvasser was monitored. Only thereafter was this interviewer given further addresses to canvas. All questionnaires filled out were checked for completeness and accuracy; further, after the completion of the canvas, one quarter of all interviews were checked by telephonic contact with the interviewed person.

On the average, each interviewer had 19 interviews. This reaction of the interviewees was mostly positive. Thus -- according to the interview protocol -- only 4% of all conversations were perceived as unpleasant; the helpfulness of all interviewees was also rated favorably by the interviewers (71% of all interviewees were described as very helpful). /23

2.5 Evaluation

The evaluation was carried out at the computer center of the

University of Zurich, with the help of the Integrated Evaluation Program Packet SPSS (Statistical Package for the Social Sciences). Before it was possible to begin with the actual data analysis, it was necessary to connect the accoustic calculation -- or measurement results with the canvassing data. For this purpose, a purification of the interview data was carried out (compilation of partial questions, selection of class divisions, formation of simple indices), as well as the determination of simple answer frequencies (cf. Appendix III). The evaluation work in the more narrow sense was carried out subsequently by phases -- always based on the analysis preceding the results -- and in continuous communication with the coordinations group. /24

3. NOISE MEASUREMENTS AND CALCULATION MODEL*

3.1 Development

The acoustic foundation for the study is the known flight noise for each canvassing location. For this purpose, equal noise stress was indicated on the best maps. These curves could be provided with either a great number of individual measurements or by means of a computer model.

To determine the chief relationships between the various operating conditions of the aircraft in the airport area, and the corresponding noise stress on the ground, various measurement series were carried out, the first of which was in June 1975 in Grenchen. Based on the data from these measurements, the acoustic parameters were determined for a computer model.

The flight noise stress values calculated with this model were used to define the canvassing areas. The acoustic values

*This chapter was written by the representatives of the BZL in the coordinations group.

corresponded to monitoring measurements with a tolerance of about ± 3 dB.

3.2 Noise scale used

The intensities of the quietest and loudest audible noises stand in a ratio of 1:1 billion (10^{12}). In order to comprehend this huge range, noise intensity is expressed in terms of a logarhythmic scale. This scale, called noise level, is expressed in the unit of "decibels" (dB).

The human ear evaluates a noise chiefly by its noise strength (intensity) and tonal composition (spectrum). Thus it senses very /25
high and very low tones, at the same intensity, as being less loud than middle range tones. This property of hearing is dealt with in noise measurements by a corresponding evaluation characteristic. The broadest evaluation is the filter curve designated A. An A-evaluated noise level is usually designated with the symbol L_A, and the measurement unit is the dB(A).

A noise source passing by a certain measuring point causes a noise level which at first increases, then reaches a maximum, and finally sinks. This noise level maximum L_{max} ($L_{A\ max}$ if A-evaluated) is usually given for the characterization of an individual noise event, as for example the overflight of an airplane. For several overflights, a mean noise level maximum $\overline{L}_{A\ max}$ can be calculated.

The L_{eq} is the value of the average noise intensity for a certain period, and this also is called the mean level. This is used for the total evaluation of a large number of individual noise events of various durations and intensities(noise stress measure). This evaluation is based on the concept that a higher noise level over a short period is just as disturbing as a lower noise level over a longer period. For a steady L_{eq}, where there is doubled noise intensity, there must be a halved effective duration. The doubling of the noise intensity corresponds to an increase of the noise level of 3 dB; subjectively, a noise is perceived as being doubled in loudness if the level is increased by about 10 dB(A).

In the present study, the noise stress is represented by two measures: first, by the mean level L_{eq} in dB(A) with an averaging time of one hour, secondly by the mean noise level maximum $\overline{L}_{A\ max}$. The stresses are given for the individually studied airports in Appendix I: The L_{eq} as curves of equal stress, and the $\overline{L}_{A\ max}$-value as individual points. /26

3.3 Computer model

The comprehensive description of the computer model is the subject of a separate report. The following parameters are considered:

- The aircraft types are divided into categories with similar or comparable acoustic properties, namely into groups of training and towing aircraft, one-motor cruising aircraft, two-motor cruising aircraft, turbo-prop and jet aircraft.

- In Buttwil, the helicopter training is also included.

- The number of standard flight events is taken from the appropriate traffic statistics: the mean hourly movement number during the twelve house of daylight of the two heaviest traffic week days of the six heaviest months. The hours of the day taken is the period between 0800 and 2000 hours. Take-off and landing counts as one event.

- The flight paths from publicized* arrival and departure procedures.

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*In the AIP for Switzerland

- The noise level maxima and their dependency on distance (damping) from measurements and frequency analyses.

- The flight characteristics, that is speed, climb rate, and corresponding power settings from flight handbooks.

- The effective duration of individual noise events, i.e. the duration of the period where noise level is higher than $\bar{L}_{A\ max} - 10$ dB(A). This depends on the distance of overflight, and the speed of the aircraft.

- Larger topographical influences on overflight distance and noise propagation (screening, lacking or additional ground damping) are included in the mapping of the individual stress curve points.

3.4 Environmental noise, excluding flight noise

To answer the question concerning the influence noise from other sources might have on the disturbance from flight noise of light aircraft, environmental noise was identified /27
as an additional criterion for the evaluation. The environmental noise was measured in a time period shortly after the canvas in the appropriate areas, and then was assigned to each interview point by a detailed analysis. /28

4. DESCRIPTION OF THE SIX INTERVIEW AREAS

The Study is laid out in such a way that events peculiar to an individual airport can be gone into only in the exceptional case. But since the individual areas exhibit their own characteristics in terms of settlement structure and population, and since this might not be without influence as a marginal condition, the following data, interesting in this connection, is presented.

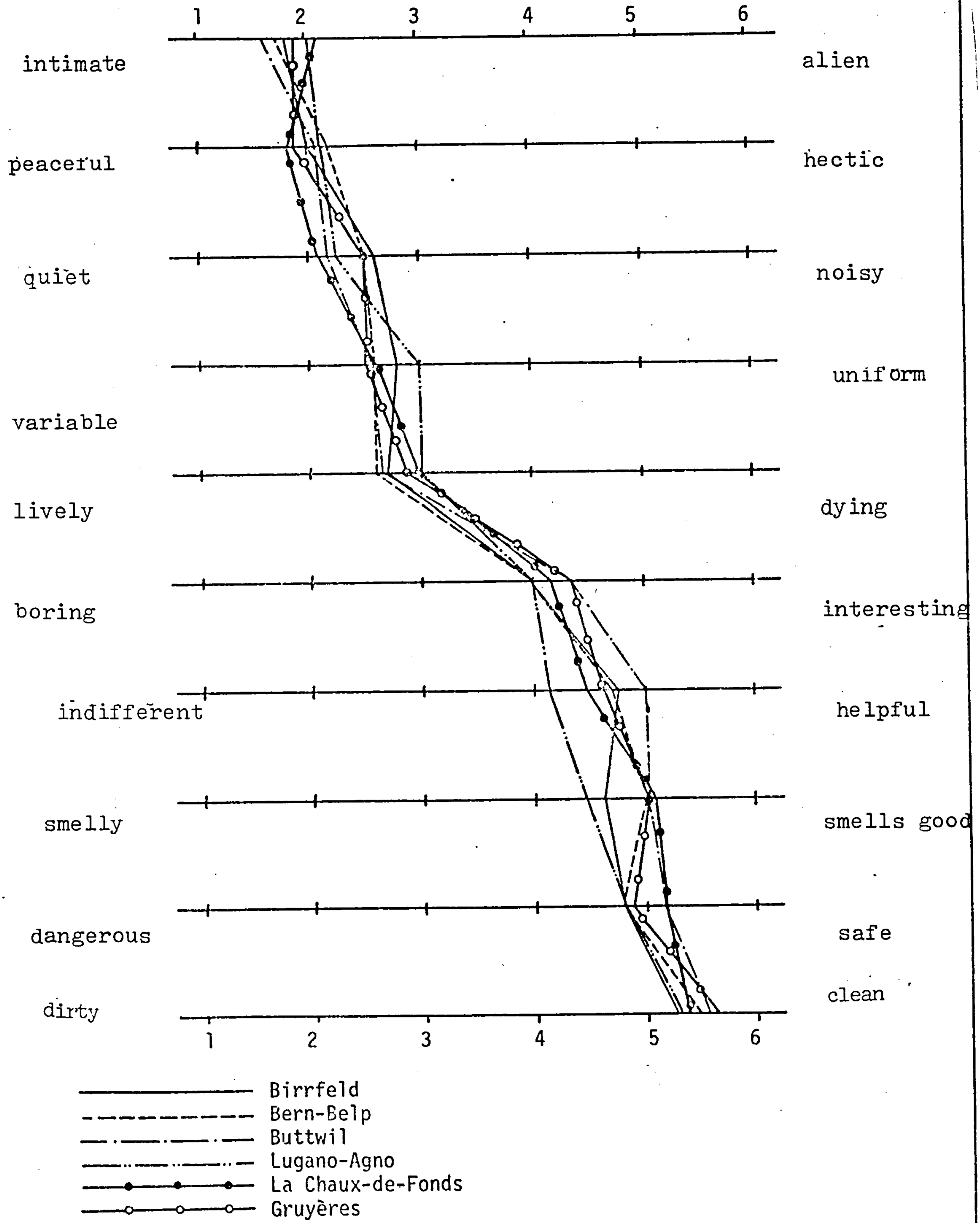
The general topographic structure of the six areas and their settlement geography is given in the maps of Appendix I. If one considers only the effectively interviewed households, the six areas can be arranged on a continuum of "rural-urban" as follows: La Chaux-de-Fonds/Lugano-Arno and Bern-Belp/Gruyeres and Birrfeld/Buttwil.

The two extreme areas in terms of this continuum can be described by saying that in La Chaux-de-Fonds 76% of the households are in an urban setting, i.e. in the city center or in heavily settled areas on the edge of the city, while only 3% of the households are in the rural, agricultural settlement area. In the canvassing area of Buttwil, 0% of the households are in an urban setting, but 85% are in what can be designated only as rural area.

Corresponding to the area character, the house types vary in the six areas. The type of house which seemed to dominate in LaChaux-de-Fonds is the large rental building (53% of the interviewed households); in Lugano-Arno the single family dwelling (31%) and the two family or row house (30%); in Bern-Belp the single family house (27%); in Gruyeres and in Birrfeld the single family house (45% and 54% respectively); and, finally, in Buttwil the single family dwelling (51%) and the farm house /29
(31%).

In view of the greatly varied settlement structure in the individual areas, visible in this data, the result of the airport-related "Polarity Profile of the Residential Environment", which was included in the canvassing process, is quite astonishing: as Figure 3 shows, the six profiles are largely identical; the largest deviation is found in the dimension "apathetic - helpful", but even here the difference between the two mean values comes to only 0.87 scalar points.

Figure 3: Polarity Profile of the Residential Area (Question 32)



The mean duration of residence of the interviewees in the individual areas came to more than 20 years for the areas of Buttwil and La Chaux-de-Fonds, and between 10 and 20 years for the other areas; in terms of apartments (or houses), the length of residence came to a mean for all areas of between five and ten years. The ownership data for the occupants again reflect accurately the city-country proportions. As expected, the proportion of home owners is highest in Buttwil, with a segment of 78%, and is lowest in La Chaux-de-Fonds with a portion of 22%. It is worthy of note that the portion of home owners is higher for all these areas, with the exception of La Chaux-de-Fonds, than for the Swiss mean value (28.1% for 1970; estimate for 1980, below 25%). This is attributable to the relatively rural setting of these airports.

The socio-demographic composition of the population is widely divergent in the six study areas. Several important characteristics are compiled in Table 4. Especially noteworthy are the following findings: the highest rate of employment is in the rural areas of Buttwil and Birrfeld, and the lowest is in the urban area of La Chaux-de-Fonds, which on the other hand has the highest rate of retired. It also has the highest porportion of persons over 60 years old, at 33%.

In terms of the occupational structure, there are clear trends: in La Chaux-de-Fonds, blue collar workers dominate (64%); in Bern-Belp, white collar workers (44%) and in Buttwil, agricultural workers (41%); large contingents of self-employed /30
and employees with higher positions were determined for Lugano-Agno (32%), Birrfeld (28%), and Bern- Belp (27%). This occupational structure is also reflected in the income levels, which are highest in Bern-Belp and Birrfeld, and lowest in La Chaux-de-Fonds and Gruyeres, in terms of mean values. With respect to the break-down of distribution between sexes, it is notable that in

TABLE 4. SOCIO-DEMOGRAPHIC DISTRIBUTION OF THE INTERVIEWEES BY STUDY AREA (IN PERCENT, ROUNDED OFF)

Characteristic	Areas						TOTAL
	CHAUX-DE-FONDS	LUGANO-AGNO	BERN-BELP	GRUYERES	BIRRFELD	BUTTWIL	
Employment situation							
Employable	33	38	37	37	43	43	39
Managing household	39	45	40	35	45	41	42
Student	4	3	9	6	3	5	5
Retired	22	12	15	21	10	11	15
Sick	2	2	--	1	--	--	1
Occup. group of Head of Household							
Laborer	64	31	21	47	27	28	35
White collar employee	20	35	44	22	37	18	30
Agricultural	3	3	8	7	9	41	11
Self-employed	4	14	7	12	8	7	9
Higher positions	9	18	20	11	20	7	15
Education							
Primary school	48	9	16	51	23	28	26
High school	12	24	10	18	10	16	16
Business school	18	40	43	16	47	47	36
Middle level or higher trade school	15	21	23	10	13	7	16
College	4	3	7	5	5	2	4
Other	3	2	1	2	3	1	2
Income							
Up to Fr. 2,000.--	49	36	28	51	25	41	38
Fr. 2,001 to 3,500	37	34	32	36	37	38	35
More than 3,500	14	30	40	13	38	21	27
Sex							
Male	36	35	39	40	46	46	40
Female	64	65	61	60	54	54	60
Age							
Up to 35 years	25	25	32	32	30	36	30
36 to 60 years	42	50	45	40	47	43	45
Over 60 years	33	25	23	28	23	21	25

all areas, the proportion of women dominates. This preponderance is the more pronounced, the more urban the settlement structure of the area.

5. RESULTS OF THE STUDY

5.1 Noise and other environmental considerations in general

This first section consists essentially of the results of the counts of the simple answer frequencies (cf. also Appendix II). Therefore -- in accordance with the broadly define thematic of the study -- it is necessary first of all to compile background information for the sake of understanding the significance of the noise of general aviation in the more comprehensive context of the total noise or enviornmental situation.

5.5.1 Perception and evaluation of the environmental quality of the residential area

Questions 3 to 10, 33 to 40, and 44, serve to elucidate the environmental relationships in the immediate vicinity of the residential area.

In this context, the common disadvantages of the area were elicited (Question 10) by giving the possible answers by means of a list, a conscious decision was made to omit the possibility for the interviewee to give disadvantages to the canvasser "at will." The frequency for those answer categories required by the theme of our study are compiled in the following Table (next page).

Table 1: Responses naming noise and other environmental disadvantages.

DISADVANTAGES OF THE RESIDENTIAL AREA	RANK AMONG ALL DISADVANTAGES NAMED	RESPONSES IN PER CENT OF ALL RESPONDENTS
Street noise	1.	15.5 %
Flying noise	4.	13.2 %
Smoke/smells/ bad air	8.	3.7 %
Noise:neigbors/children	9.	3.6 %
Danger of traffic accid.	12.	2.2 %
Railroad noise	14.	2.0 %
Sounds of shots fired	16.	1.2 %
Industrial/commer. noise	17.	0.9 %
Agricultural noise	20.	0.3 %

Street and aircraft noises are thus seen to be relatively the most important disadvantages, with a distinct interval from the other disadvantages; furthermore, both are right at the top of an absolute ranking of disadvantages. By comparison: ranks two and three were taken by "difficult to shop" and "bad public transportation connections".

The significance of noise for the general perception of well-being in the residential area is even more pronounced if the disadvantages mentioned for the area are contrasted with the advantages mentioned for the area mentioned by the respondents:

1. Location in a green, beautiful area.
2. Peaceful location.
3. Pleasant here; we feel comfortable here.
4. Good air.

   Etc.

These first four ranks show that environmental quality has a higher significance in the evaluation of the general residential situation than, for instance, closeness to the place of employment, closeness to shopping and recreational facilities, good connections with public transportation, or schools for the children.

A confirmation of the general tendency is provided by the answers to questions 7 and 8, concerning the reason for a planned, or possible, move to another residence, or even to another community. Here, as well, street noise and flying noise come in the first two ranks, followed by smell and exhaust gases, or the noise of neighbors and children. Thus the first four ranks are identical with the questions dealing with the disadvantages of the residential area. The segment of the interviewees naming street or flying noise as a (possible) reason for a move to another location, came to about 8% for traffic noise, and 5% for flying noise.

In addition to the quantitative significance of the various considerations mentioned here, dealing with quality of life (in the sense of their distribution), the qualitative significance is also of interst. To study this, questions 33 through 40 were included, in which the causes for various levels of subjective consideration of personal well being were examined. The four stages were defined as follows:

1st stage: nuisances which "make one angry"
2nd stage: nuisances which "massively disrupt well being"
3rd stage: nuisances which "could have a negative effect on health
4th stage: nuisances which "could endanger life"

Where the interviewees indicated the existence of such nuisances, they were questioned about the causes. The results of this question sequence are compiled in Table 2.

TABLE 2. SUBJECTIVE NUISANCES AFFECTING QUALITY OF LIFE

(ENVIRONMENTAL) CAUSE OF THE NUISANCE	DEGREE OF THE NUISANCE							
	SLIGHT DISTURBANCE OF WELL BEING		MASSIVE DISTURBANCE OF WELL BEING		ENDANGERS HEALTH		ENDANGERS LIFE	
	%*	RANK	%	RANK	%	RANK	%	RANK
Street noise	10.4	1.	3.2	1.	2.5	2.	1.6	2.
Flying noise	10.3	2.	2.5	2.	1.9	3.	0.8	3.
Construction	5.0	3.	0.4	6.	0.3	8.	0.4	5.
Smell, exhaust	4.8	4.	1.3	3.	3.6	1.	0.6	4.
Noise of neighbors/children	2.5	5.	1.0	4.	0.8	5.	0.2	7.
Danger of traffic accident	2.4	6.	0.3	7.	0.4	7.	5.0	1.
Smoke, dirt	2.0	7.	0.2	8.	1.1	4.	0.1	8.
Railroad noise	1.3	8.	0.5	5.	0.6	6.	0.3	6.
Sound of firing	1.1	9.	0.0	10.	0.0	10.	0.0	9.
Industrial/commercial	1.1	9.	0.2	8.	0.2	9.	0.0	9.

* The percentages are with respect to the total of all respondents (1430)

A comparison by columns shows that traffic and flying noise consistently figure in the first three positions; only in terms of endangering health or life does another item take first place (smell, gases or danger of accident caused by traffic).

In a line-by-line comparison of the percentages for the various nuisance stages, there is seen to be a systematic difference between the various types of noise on the one side and the other nuisances on the other. While the percentage of the nuisances caused by noise decrease from left to right, i.e. with increasing degree of nuisance, practically without exception; irritations arising from air quality are over-proportionally linked with an endangement of health, and -- even more pronouced -- the nuisance related to the danger of traffic accident is linked with an endangerment of life in itself.

In summary, it can be said that in the areas studied, it is true that the noise from aviation is the second most important disadvantage of the residential area, following the noise of street traffic, in terms of a nuisance degrading the quality of life, as far as the respondents were concerned. But the disturbance of general well-being caused by this noise -- in direct comparison with other nuisances or dangers -- can hardly be considered as massive.

5.1.2 Flying noise, street noise and railroad noise in direct comparison

Figure 3 shows the frequencies with which all the noise sources dealt with were named; the height of the column represents the proportion of interviewees in each case who said that they heard the noise "during the summer, all day long, from outside". (Question 44). Here it was simply a matter of the perception of the noises, and not of the evaluation of the noises, or the stresses caused by the noises. The noise of special interest to us, that of street traffic, airplanes and railroad trains, is represented by shading. Here, too, the noise of airplanes is only a relatively small distance behind that of street traffic, thus having second place. In light of the fact that the canvass was restricted to the vicinity of airports, and that the radius of this area was only a few kilometers, it is somewhat remarkable that airplanes were only spontaneously named as the cause of perceived noise by somewhat more than half of the respondents.

Because of the location of the households studied, right in the path of the aircraft, it would have been expected to have higher percentages. This discrepancy, which needs to be confirmed, does itself tend to confirm the impression mentioned already in the last section (5.1.1.), that the noise of aircraft is only perceived at all in a certain part of the cases.

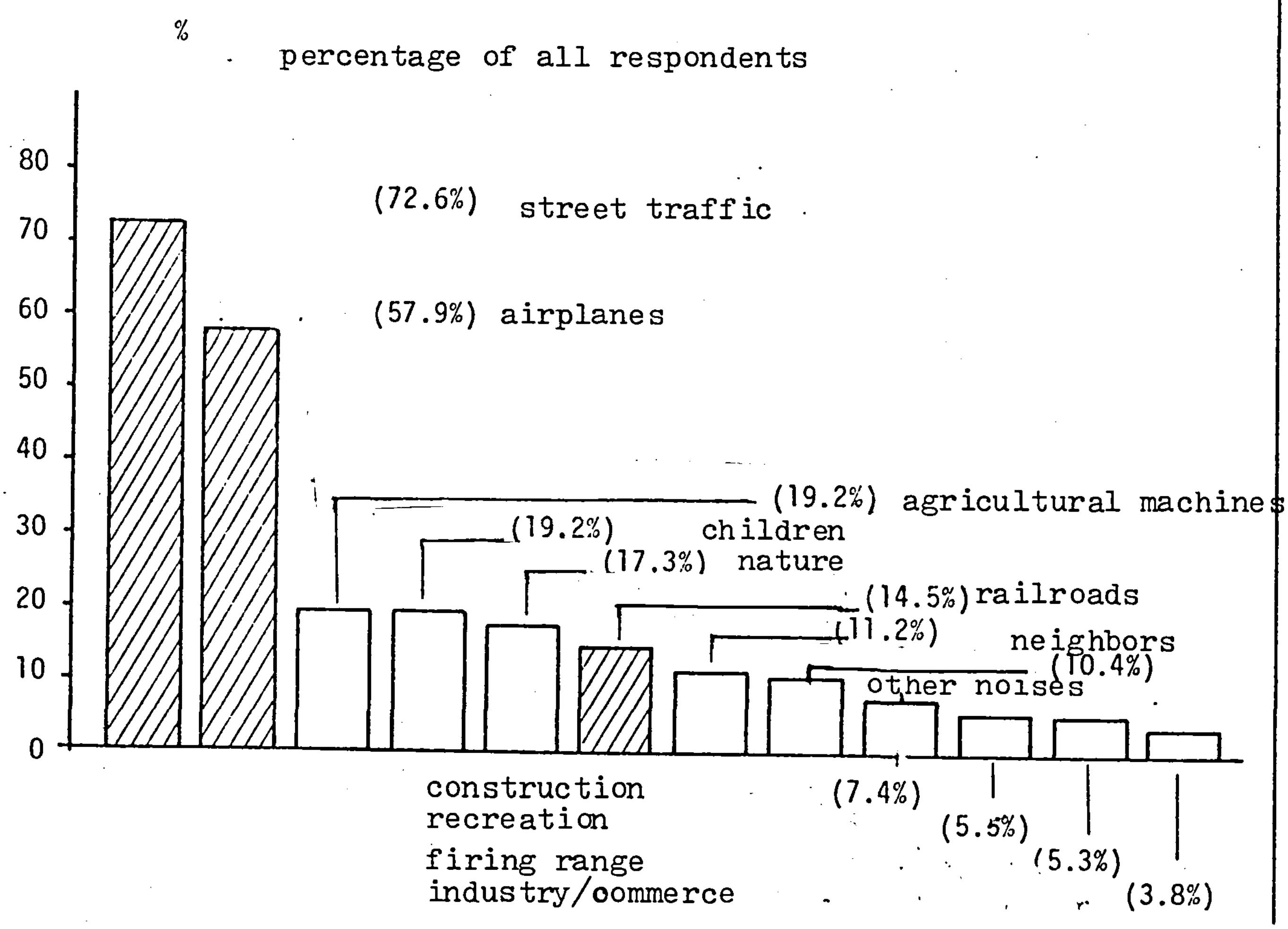


Figure 3: Noise Sources Named

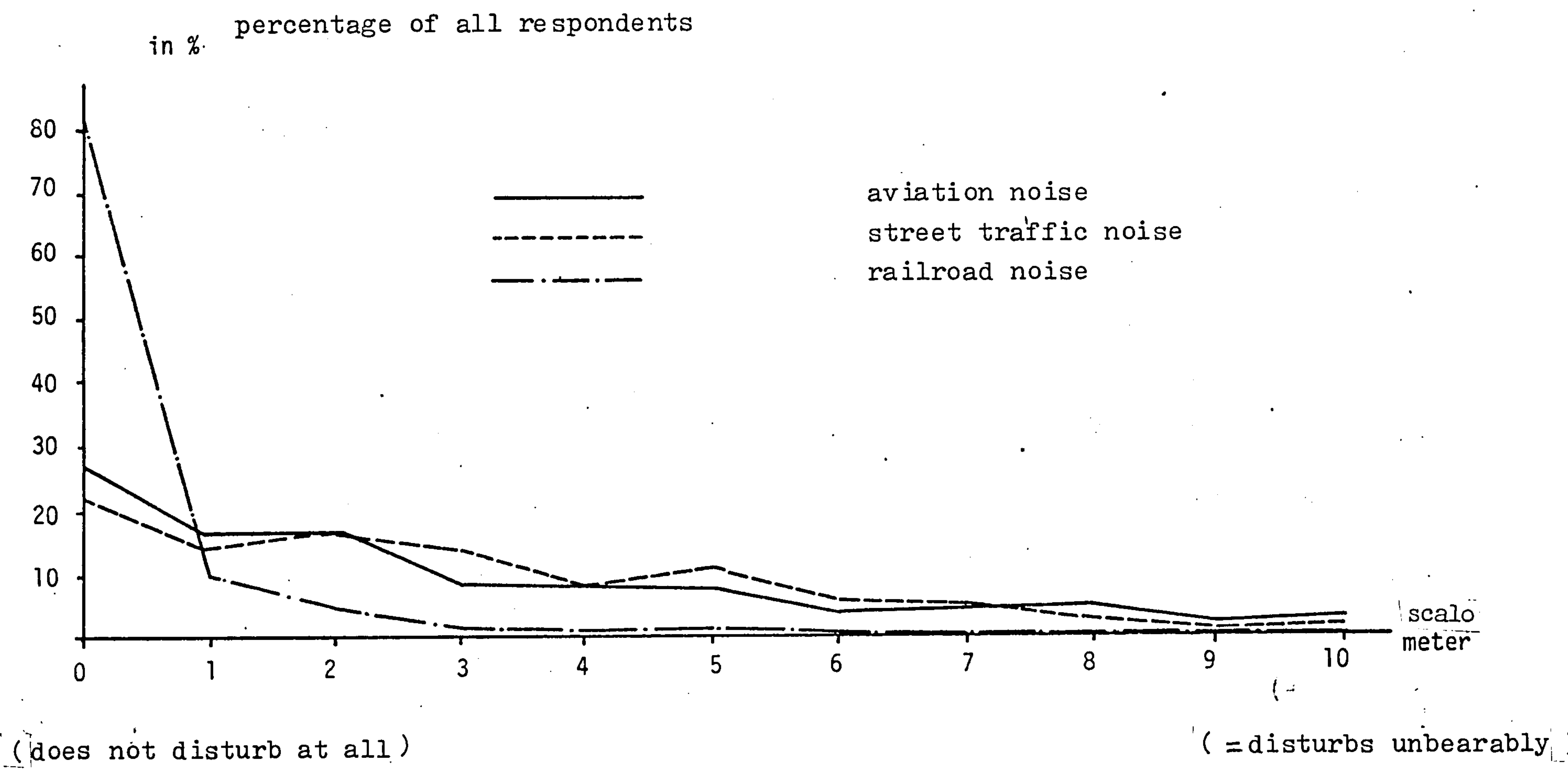


Figure 4: Distribution of self-ranking of subjective disturbance caused by three types of noise

In addition to the aspect of the perception of flying noise, dealt with exclusively up to this point, the evaluation of this noise is also of interest. Here, in a direct comparison of the noise from airplanes, traffic on roads, and railroads, it again is remarkable that there is a pronounced similarity between flying and street noise: Figure 4 shows the results of the self-ranking of the respondents concerning the disturbances, on the so-called scalometer, for the three types of noise, with the results directly contrasted. (In the scalometer, the interviewees had to rank the disturbance they perceived from the particular type of noise on a "thermometer" scale provided to them -- without any connection to the actual noise level; for the details of this measurement, cf. section 5.4.)

For all three types of noise considered, the distribution curves fall very steeply. In the case of railroad noise, this is even more pronounced than for the other types of noise due to the fact that the noise is strictly localized because of the track network. The two curves for street noise and aircraft noise are almost identical; in both cases, there were about one-fourth of the respondents, perceiving the noise at all, who ranked a stress level of 0, which is equivalent to "does not disturb at all." About a further third named stress levels of 1 or 2, which can be interpreted as a very slight subjective disturbance. The scalometer levels of 8, 9, and 10 (where 10 is equivalent to "disturbs unbearably"), were only named by a total of 6% of those who perceived flying noise.

5.1.3 Noise at the work place and in free time

In general terms, our study was limited to the disturbance caused by aircraft noise at the residence. Thinking of a possible cumulative disturbance in the case of noise emissions at home and at work or at free time locations, the corresponding noise effects were clarified. (Questions 19/20 and 28-31). The questions were limited to the relationship between the noise stress at work or recreational location relative to the noise at home. /41

It was seen that 61% of those questioned, who work outside the home, are subjected to either more noise or just as much noise at work as they are at home; only 29% of those questioned said that it was quieter at work than at home, or that the noise level was equal. For those persons who experienced as much noise as, or more noise than at home when they were at work, there were questions dealing with the source of the noise. It was seen that again street traffic noise took first place. But in this connection, flying noise only took fifth place. Thus, it had only a subordinate importance (cf. Table 5). Nevertheless, it is seen from these results that about every twelfth employed person questioned felt himself to be disturbed by the noise of aircraft, not only at home, but also at work.

TABLE 5: EXTERNAL NOISE SOURCES AT THE WORKPLACE

RANK	TYPE OF NOISE	BY PERCENTAGE
1.	Street noise	62
2.	Industrial noise	14
3.	Other noise	13
4.	Railroad noise	12
5.	Aircraft noise	8
6.	Noise from neighbors/children	7
7.	Noise of firing shots	3
8.	Agricultural noise	3

(N = 532 = Interviewees employed outside the home who designated their workplace as being either as loud as or louder than at home)

In terms of the disturbance caused by aviation noise in /42 locations used for recreation, there is a similar picture: only every 20th person said that because of aviation noise the place where he spends free time in the summer is as loud as or louder than it is at home. In terms of free time, it is to be remarked that about 3% of all persons questioned said that they preferred to spend free time away from their homes due to the noise stresses they experienced at home.

5.1.5 Excursus: air and water pollution

One-third of all interviewees (35%) said that there was some type of perceptible environmental pollution in the immediate vicinity of their homes. The first rank was the mention of smell (22%), followed by air pollution with 13% and water pollution with 7%. In addition, when questioned about the degree of disturbance signified by this pollution, the following picture arose (given in percentages of all respondents):

TABLE 6: DISTURBANCE CAUSED BY ENVIRONMENTAL POLLUTION

DEGREE OF DISTURBANCE	TYPE OF POLLUTION		
	SMELL	AIR POLLUTION	WATER POLLUTION
"Very strong"	4%	3%	2%
"Only somewhat/little"	16%	9%	4%
"Not at all"	2%	1%	1%
TOTAL	22%	13%	7%

Independent of the type of enviornmental stress, there was additional questioning involving the perceived cause of the trouble. Here many answers were possible. The rank list shows that in the perception of the respondents, the operators and aircraft of the airports only have a minor role in terms of being the cause of environmental stress. Named as the causes of environmental pollution were: /43

1. Motor vehicles (by 10% of all answering)
2. Agricultural operations (7%)
3. Canalization (6%)
4. Industry and commerce (5%)
5. (Oil-) Heating, central heating planst (3%)
6. Rubbish burning, land fill (3%)
7. Airplanes/airports (2%)
8. Unknown causes (0.1%)
9. Railroads (0.1%)

5.2 Disturbance caused by the noise of general aviation

5.2.1 Disturbance according to aircraft type

Of the 824 interviewees (= 58% of all interviewees) who explicitly named airplanes as the cause of noise which they heard at home, 4% gave no response, and 10% were not able to differentiate among various types of aircraft. The spontaneously given responses of the other interviewees were distributed as follows among the various categories (multiple responses possible):

(Figure 7 on following page.)

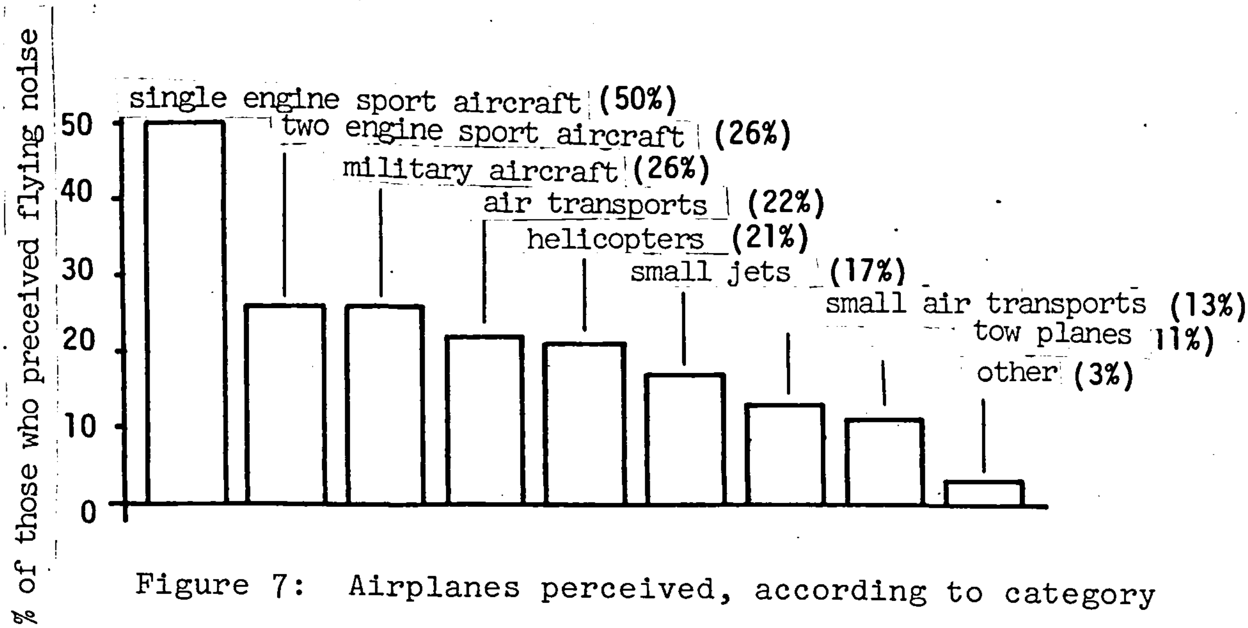


Figure 7: Airplanes perceived, according to category

If one considers the ranking of the aircraft categories /44 perceived, it is noticeable that the two categories representing types either never or seldom using the nearby airport, namely military aircraft and large air transports, appear already at third and fourth rank: thus military aircraft were named by about three-fourths of those respondents near the airport at Buttwil, who perceived aircraft noise, and by about half of those near the airport at La Chaux-de-Fonds and Gruyeres; the corresponding percentages for the other study areas are relatively small by comparison. Large transport aircraft on the other hand only play a significant role in the area influenced by the airport at Birrfeld: about two-thirds of all interviewees, who perceived flying noise at all, also named airlines as the cause of the noise. For all other airports, the corresponding proportion was about one-fifth (in Bern-Belp and in Buttwil) or even lower.

In addition to the perception of various categories, questions were also presented, asking which aircraft types "disturbed especially strongly". For clarity, in the right column there is given the mean scalometer value for total flying noise disturbance. Here it must be noted that this scalometer ranking is for flying noise as a whole, and not for the one category alone. But as a signal of a trend, this scalometer mean value can be taken without any difficulty for the individual aircraft categories. (Table 8)

/45

TABLE 8: DISTURBANCE BY AIRCRAFT TYPES

AIRCRAFT CATEGORY	Percentage saying they are strongly disturbed, of those perceiving noise	Mean scalometer reading* for this disturbance
1. Single-engine sport airplane	23%	5.7
2. Military aircraft	19%	5.0
3. Small jets	13%	4.8
4. Two-engine sport aircraft	12%	5.0
5. Helicopter	11%	4.6
6. Large air transports	11%	4.4
7. Tow planes	6%	6.2
8. Small air transports	3%	4.0

* For comparison: the minimum of this scale is 0, maximum 10.

Overall, the information given in Figure 7 and Table 8 shows that both qualitatively (Table 8) and quantitatively (Figure 7), single-engine sport airplanes play a dominating role in the problem of disturbance caused by noise: about 50% of all those questioned who hear noise from aircraft at all attributed disturbance to this type of aircraft, and every fourth person of these considered himself to be strongly disturbed by this noise (whereby in this case "especially strongly disturbed" corresponds to a mean scalometer value of 5.7).

5.2.2 Disturbance by frequency and distance of overflight /46

Roughly two-fifths of all questioned (43%) indicated that during the summer, practically no flights, or fewer than daily flights, took place in the vicinity. Of the others questioned, a mean daily overflight frequency of about 13 flights per day was given. Only about one-fifth of those questioned (19%) answered more than 20, and only every 20th person responded more than 50, and only every 50th respondent spoke of more than 100 overflights per day.

The distance at which these aircraft fly from the residence usually, was given by the respondents on the mean as being about 400 meters; 29% of the interviewees mentioned a distance from the flight of up to 250 meters, while 35% spoke of a distance of more than 800 meters.

TABLE 9:

DISTURBANCE FROM FLIGHT NOISE (SCALOMETER MEAN VALUE) BY NUMBER OF FLIGHTS AND DISTANCE OF FLIGHT PATH FROM THE RESPONDENT'S HOME

NUMBER OF DAILY OVERFLIGHTS (PERCEIVED)	DISTANCE FROM THE FLIGHT PATH (PERCEIVED)			
	Less than 250 m	251-600 m	601-2,000 m	More than 2,000 m
1 - 9	4.5	1.7	1.3	1.0
10 - 20	3.2	2.4	2.1	1.0
More than 20	6.1	4.7	3.3	0.9

The values in the table cells correspond to the scalometer value exceeded by 50% of the affected group (= median)

As Table 9 shows, the subjective disturbance increases markedly with the number of daily flights, and decreases markedly with increasing distance from the home of the flights. In the most strongly affected group (more than 20 flights per day in less than 250 meters distance) the mean scalometer value lay at 6.1. For the least affected group (less than ten flights per day at a distance of more than two kilometers) the scalometer value was only 1.0. At the same time it is seen that with a distance from the flight of more than two kilometers (cf. the far right column) the number of aircraft flying by exercises no influence on the scale of the disturbance.

/47

In the interpretation of this information, it is to be noted that these are only subjective perceptions of frequency and distance of overflights. In the formation of these perceptions, it is to be expected that the size of the disturbance will have an influence on the disturbed perception, itself. The stronger the noise of the aircraft is perceived to be, the stronger the estimation in terms of the number of overflying aircraft; and the estimates in terms of distance from the flight path will tend to decrease. However, the differences in the scalometer mean values are so pronounced from cell to cell that in spite of this assumption, it is possible to speak of a close correlation.

5.2.3 Time frame of the disturbance arising from flight noises

The disturbance arising from flight noise concentrates very markedly on certain times of year, days of the week, and hours of the day. Thus, about 85% of respondents feeling themselves to be disturbed by flight noise (response on the scalometer of three or more) named summer as the season in which the aircraft disturb them most. Then, there were 16% who named the spring, 13% who /48
named the autumn (multiple answers were possible). This probably is not related so much to the actual operations of flying, but

rather with the usual time spent in the open air by the population during the warmer half of the year. Only exactly 9% considered the disturbance from aircraft noise to be independent of season (responding "disturbed about the same in all seasons"). There were practically no responses naming winter.

The dominance of summer operation can be confirmed in all study areas; this is weakest in Buttwil, where the corresponding proportion of responses was only 71%. There are significant differences among the various airports in terms of the evaluation of the disturbance in spring and autumn; the responses falling in these seasons come, in the cases of the airports at Buttwil, La Chaux-de-Fonds and Gruyeres, to about 50%, and in the case of Birrfeld and Lugano-Agno to 25% each. In the case of Bern-Belp this is only 5%.

Just as remarkable is the strong concentration of subjective disturbance during the weekends. Fifty-nine per cent of all those questioned who felt themselves to be disturbed by flight noise said that the airplanes disturbed the most on Saturday and Sunday; there were 21% for whom the noise was equally disturbing on all days of the week. Only 12% felt that they were most disturbed on work days -- A further 7% felt that the disturbance was largely dependent on the weather. Here, too, there seems to be a reflection of the fact that, in addition to the concentration of flying on weekends, the free time behavior (time spent outdoors) of those employed would be concentrated on weekends, and that they would be more likely to be at home during that time.

Among the individual airports, there were some very pronounced differences. The disturbance, for instance, on weekends in the cases of Birrfeld and Buttwil, is much stronger than the average, while it is weaker than the average at Lugano-Agno,

La Chaux-de-Fonds and Gruyeres. It is also remarkable that in /50
the cases of the two airports lying in French-speaking Switzerland -- La Chaux-de-Fonds and Gruyeres -- the responses falling on weekdays are significantly above the average, falling at about 25%. It is also notable that the proportion of those questioned who felt that disturbance was dependent on weather were far above the average response rate for the other airports in the case of Lugano-Agno. The response rate there was 20%.

The responses of the interviewees concerning the hours of the day during which the airplanes disturb the most, are given in Figure 10 in the form of a curve (extended curve), and also given there is the proportion of respondents who are usually at home during the corresponding times of day on weekend days. The curve shows that disturbance caused by flight noise is most heavily distributed in the early afternoon. Since at the same hours the proportion of persons at home is the smallest, it must be concluded from the contrasting curve that among those respondents who are spending their weekend afternoons at home, there is a large majority who feel disturbed by flight operations.

Overall, the answers of the interviewees concerning times of the disturbance perceived from flying noise reflect quite accurately the actually operating hours of the studied airports, insofar as these are known to us.

5.3 Construction of a scale for measuring subjective disturbance arising from aviation noise

To measure the subjective disturbance caused by the noise of small aircraft, two different scale types were utilized -- in agreement with noise studies carried out earlier:

- the scalometer (with values of 0 to 10, abbreviated: SKALO)

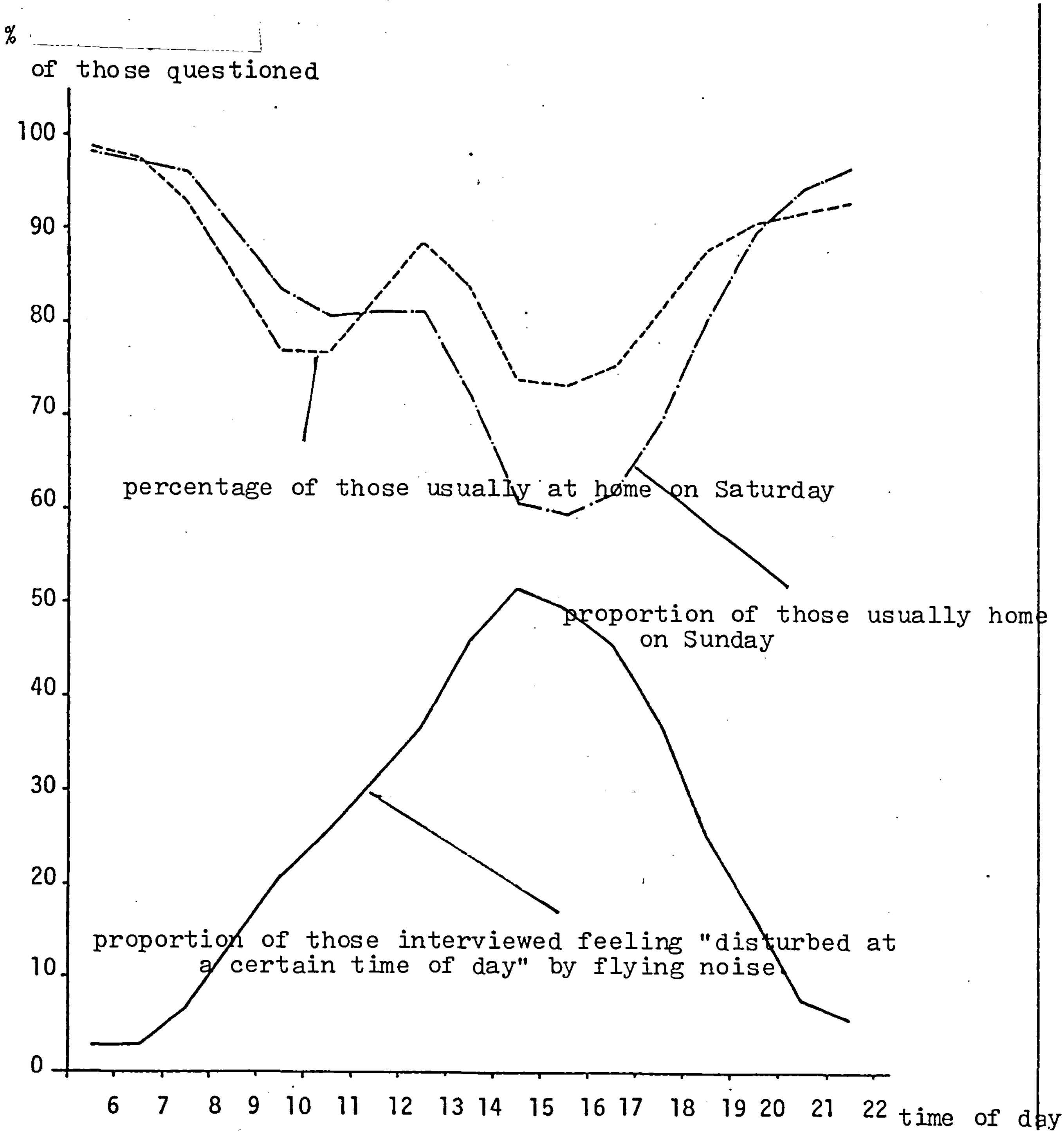


Figure 10: Disturbance by hour of the day

- a combined scale, compiled of eleven individual disturbance components, (with values of 0 to 11, abbreviated: STOER)

/51

In the case of the scalometer, which was adopted unchanged from earlier studies, the interviewee gives a direct self-ranking corresponding to the disturbance perceived by himself, in the form of a thermometer-like numerical scale with values of 0 to 10. Because of the direct and general translation of the subjective feeling of disturbance, undertaken by the interviewee, in terms of a numerical scale, the scalometer is basically independent of the type of concrete effects of a certain type of noise; it is well suited for this reason for the direct comparison of various types of noise.

For the construction of a combined disturbance scale STOER, after a first review of the raw data, the questionnaire gives 14 disturbance components for utilization, from which each deals with a certain aspect of the concrete effects of flight noise on perceptions, behavior modes, attitudes, or evaluations of the interviewees. These were:

DISTURBANCE COMPONENTS	QUESTION NUMBER
- Moving because of flight noise (FL) firmly planned	7
- Thinking of a possible move because of FL	8
- FL a disadvantage of this area	10
- Quality of life reduced by FL (cf. 5.1.1. Table 2)	33-40
- Fear caused by FL	53a
- Windows closed because of FL	53b
- Unable to rest properly because of FL	53c
- Staying in house because of FL	53d
- Having a hard time understanding because of FL	60a
- Wakened because of FL	60b

- **House shaken by FL** **60c**
- **Would spend more time on balcony or garden but for FL** **71**
- **Have taken action already against the airport because of FL** **72**
- **Ready to take action against the airport** **75** /52

These 14 possible components were systematically subjected to various tests, for the purpose of constructing a scale. In one of the first phases, the invidual items were checked for their distribution in the various sub-sample tests formed according to settlement -- or housing type. Based on this test, the two components "going back into the house because of FL" and "would spend more time on balcony or garden but for FL" were eliminated, since it was seen that the implicit precondition for the occurrence of these components, namely the presence of a garden or at least a balcony, would not be fulfilled for a significant portion of the population. Also excluded was the component consisting of "fear caused by FL", since a correlation test subsequently carried out with the noise stress measurements (carried out in the form of a simplified segmented curve over L_{eq} or $\overline{L}_{Amax}$) showed that there was no statistical correlation between the objective stress caused by light aircraft and the responses. Because of this finding, it had to be assumed instead that this fear -- expressed though it was by about one-third of all persons questioned -- must have been caused by low-flying military aircraft in most cases, but hardly by small aircraft.

The remaining eleven disturbance components were subjected in a second phase to a factor analysis and to a Guttman scale test:

- With the procedure of the factor analysis, it was attempted to attribute a given data quantity to a smaller one, without losing any information. In this it is assumed that there are information overlaps in the given data -- in our case, in the eleven remaining disturbance components. The factoral analysis is based on the supposition that there are background structures and dimensions which cannot be directly removed from the measured data and the simple statistical connections between them. These dimensions are named factors.

In the present case, this expectation was not fulfilled: that means, the eleven distrubance items could not be reduced to a smaller number without losing information. In other words, each of the eleven components possesses an independent significance in connection with the disturbance caused by flight noise. /53

- By means of the Guttman-scale test, the study was made as to whether or not the individual components could be formed on a single dimensional vector. This test also gave negative results, and thus indicated that our list of eleven disturbance components forms a catalog of non-substitutable disturbance components.

After the conclusion of these tests, there followed an actual scale construction, by the simple addition of the eleven components. Where none of these was present, this is equal to a reading of zero in the total index. The equal weighting of the falues of the individual components results from the fact that the assignment of values remains the same in the case of positive expression of the individual components. A conscious decision was made to do without scale variants with varying weighting of individual components (for instance caused by -- non-scientific -- criteria of relevance or corresponding to empirically-determined correlation coefficients between individual components and a certain noise stress value).

The empirical connection between the individual disturbance components and the two acoustic stress values used, L_{eq} and $\overline{L}_{Amax}$, is shown in Figures 11 and 12 in the form of partial curves.

With respect to the study of statistical connections between the noise stress values and the two disturbance values described, a spot sample correction was undertaken to ascertain that the two scales SKALO and STOER would not be disrupted by foreign influences, but would only register a possible disturbance caused by the noise of small aircraft. Therefore, all the answers of interviewees were excluded, where the following conditions were present:

- interviewees who considered themselves to be heavily disturbed by military aircraft, large air transports and/or helicopters (Question 47);

- interviewees who indicated that the aircraft flying by their houses did not originate from the nearby airport (Question 55);

- interviewees who themselves are sport fliers (Question 83), and interviewees who have regular or frequent contact with the airport or with persons working there, either privately, or in the course of business (Question 84). /56

This strict selection did, indeed, reduce the size of the sample from 1,430 to 1,013 interviewees; but at the same time there was additional guarantee that the responses of interviewees being included in the evaluation were only those reflecting disturbance actually caused by the noise of aircraft from the nearby airport. The frequency of distribution for the two disturbance scales purified in this way are given in Figures 13 and 15.

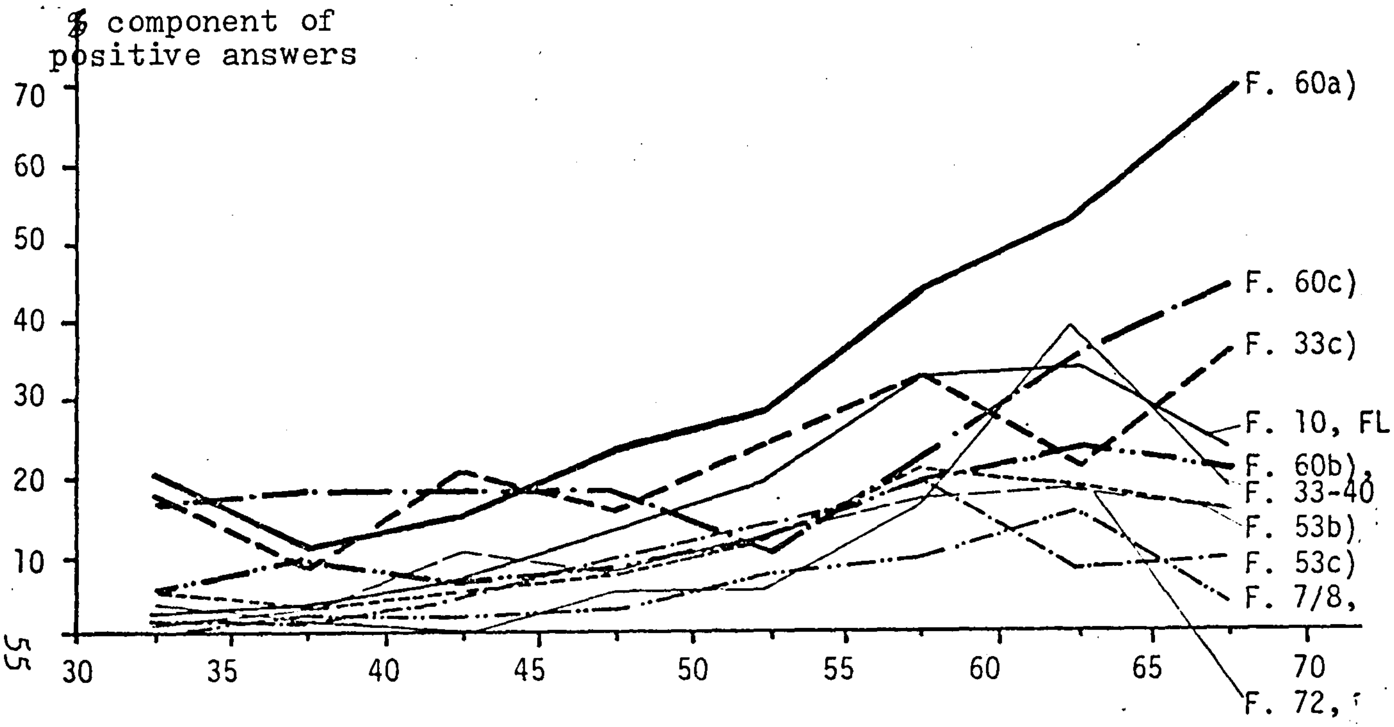


Figure 11: Constituent curves of the scale components of the combined disturbance scale over L_{eq} (% component of positive answers)

F. 60a	Often disturbance of tel., radio, TV
F. 60c	House often shakes
F. 33c	Often get angry
F 10	A disadvantage
F 60b	Often wakened
F. 33-40	FL a direct danger
F. 53b	Often close windows
F. 53c	Often cannot rest
F. 7/8	Move because of FL
F. 72	Action against FF/RF

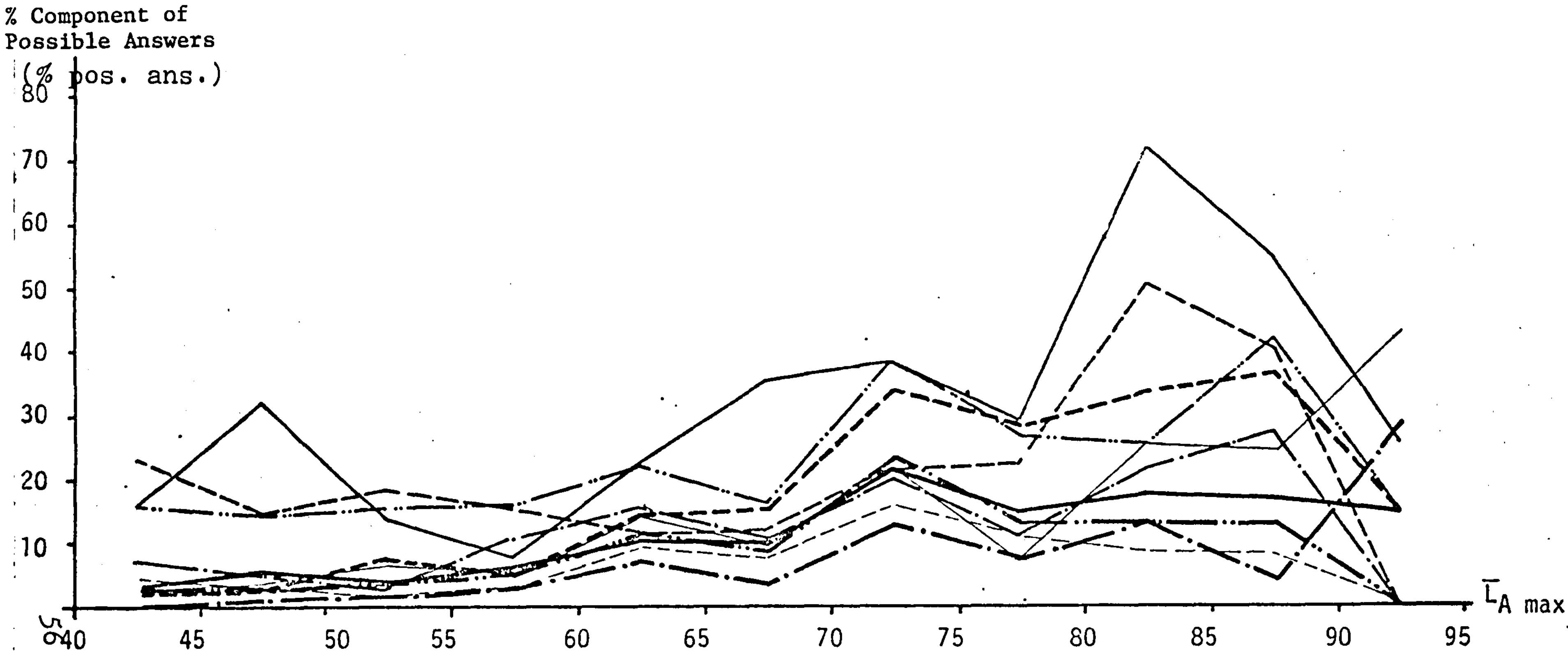


Figure 12: Constituent curves of the scale components of the combined disturbance scale over $\overline{L}_{Amax}$ (percentage of positive ans.)

F. 53b	Often close windows	
F. 10	FL a disadvantage	
F. 7/8	Move because of FL	
F. 33c	Often cannot rest	
F. 60a	Tel., radio, TV often disturbed	
F. 60c	House often shakes	
F. 60b	Often wakened	
F. 53e	Often get angry	
F. 71	Action against FF/RF	
F. 33-40	FL a direct danger	

/55

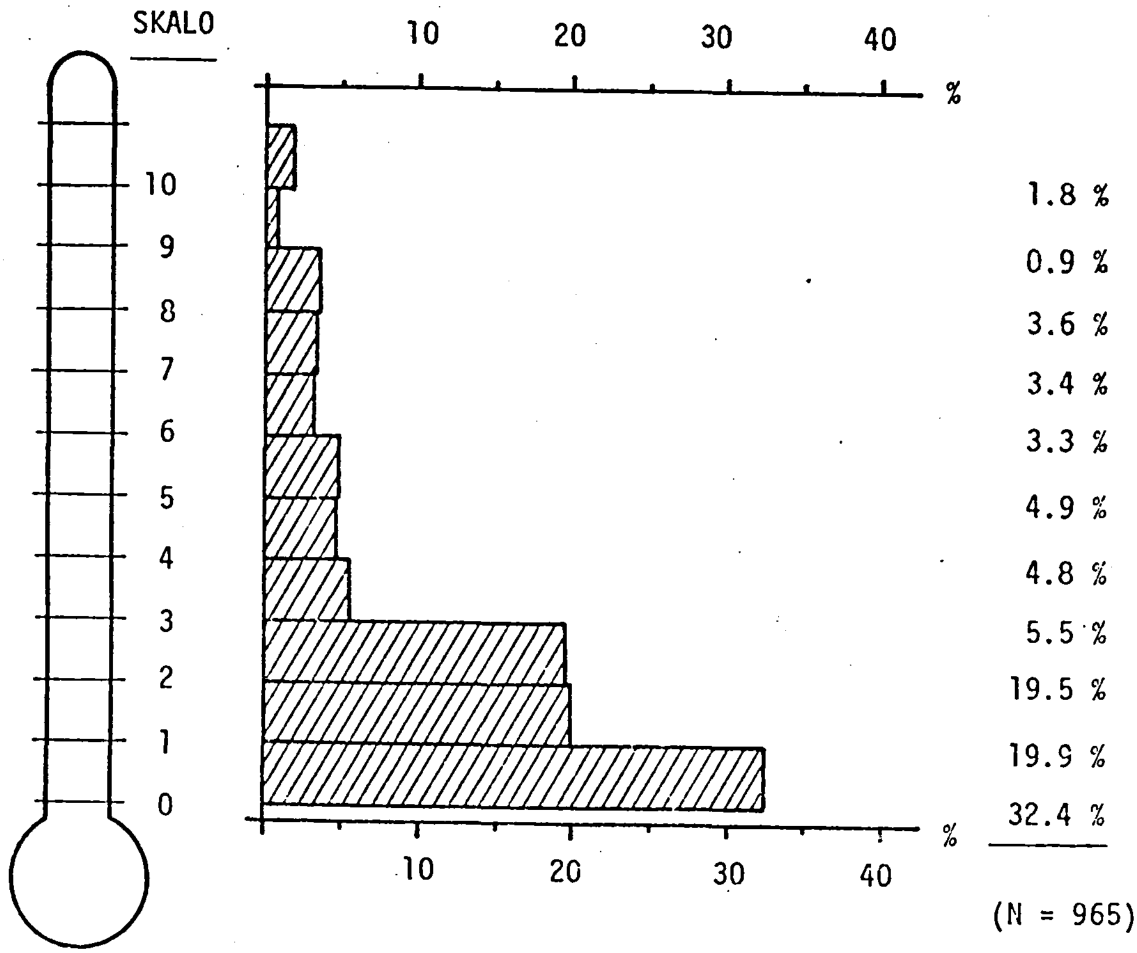


Figure 13: Frequency distribution for flight noise scalometer.

The statistical connection between the two disturbance scales is visible from Figure 15. In the dispersion diagram, the two scales form the two axes of a coordinate network in which each interviewee is represented corresponding to his position as given in the two scales, represented as a point. In addition to this graphic representation in a so-called point cloud, the statistical connection between the two scales can also be expressed numerically as a correlation coefficient*. /57

*This coefficient is based on a correlation computation which makes it possible to determine the relationship between the variation of two characteristics. The resultant coefficient is conceived in such a way that it can take values between -1.00 and +1.00. A value of +1.00 represents a completely positive relationship. (If A increases at a certain rate, then B does, as well.) A value of -1.00 then represents a completely negative relationship (if A is high, then B is low.) A value of 0 indicates that there is no relationship between the two values.

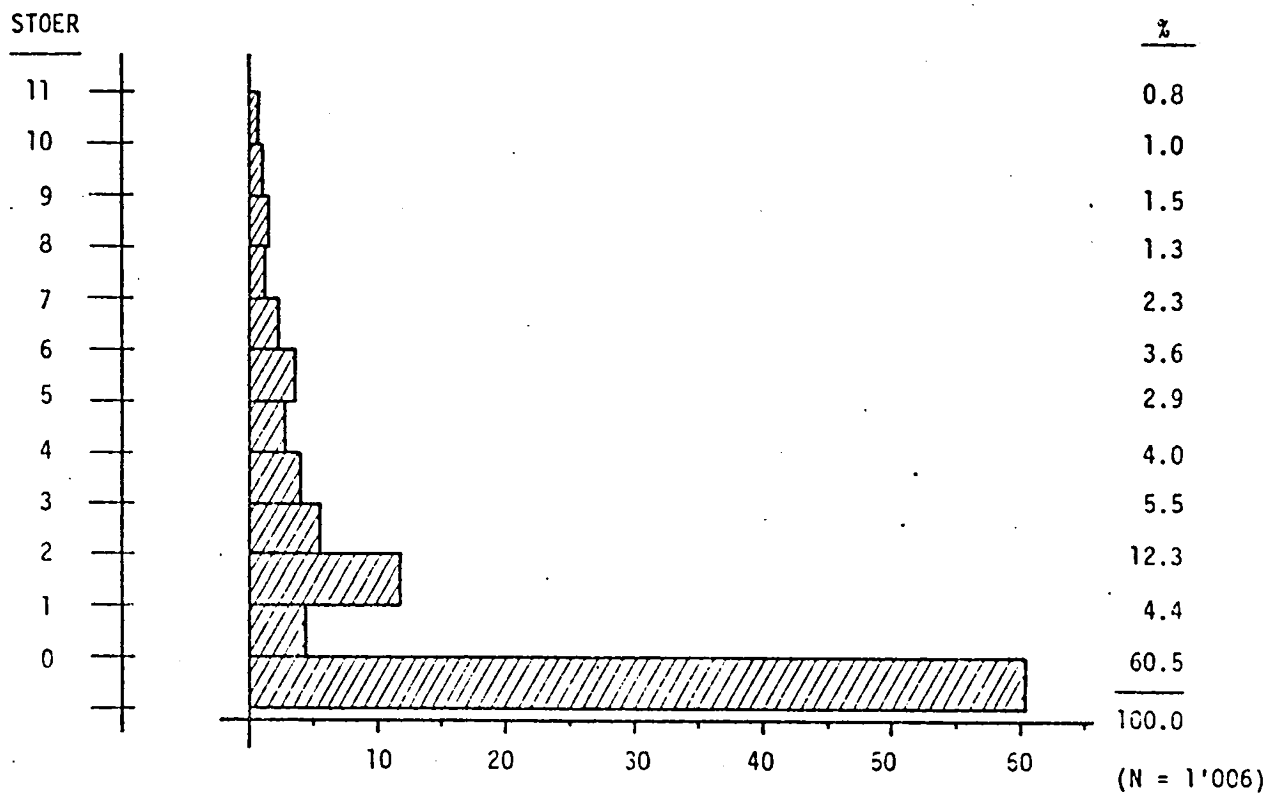


Figure 14. Frequency distribution for the combined disturbance scale (STOER)

With respect to the method planned for the further evaluation of the component curve determination, it would finally be necessary to determine fixed threshhold values for both scales to reduce the 10 or 11 value scale to two expressions "scale value above threshhold value" or "scale value not above threshhold value". For the scalometer, this threshhold value would be unchanged from earlier noise studies: namely 4 for "mean to heavy disturbance" and 7 for "heavy disturbance". The corresponding threshhold value for the combined disturbance scale would be determined in such a way that regressional analysis would permit the threshhold value of both scales to be considered to be qualitatively equivalent. This would give a threshhold value of 3 for "mean to heavy disturbance" and /58

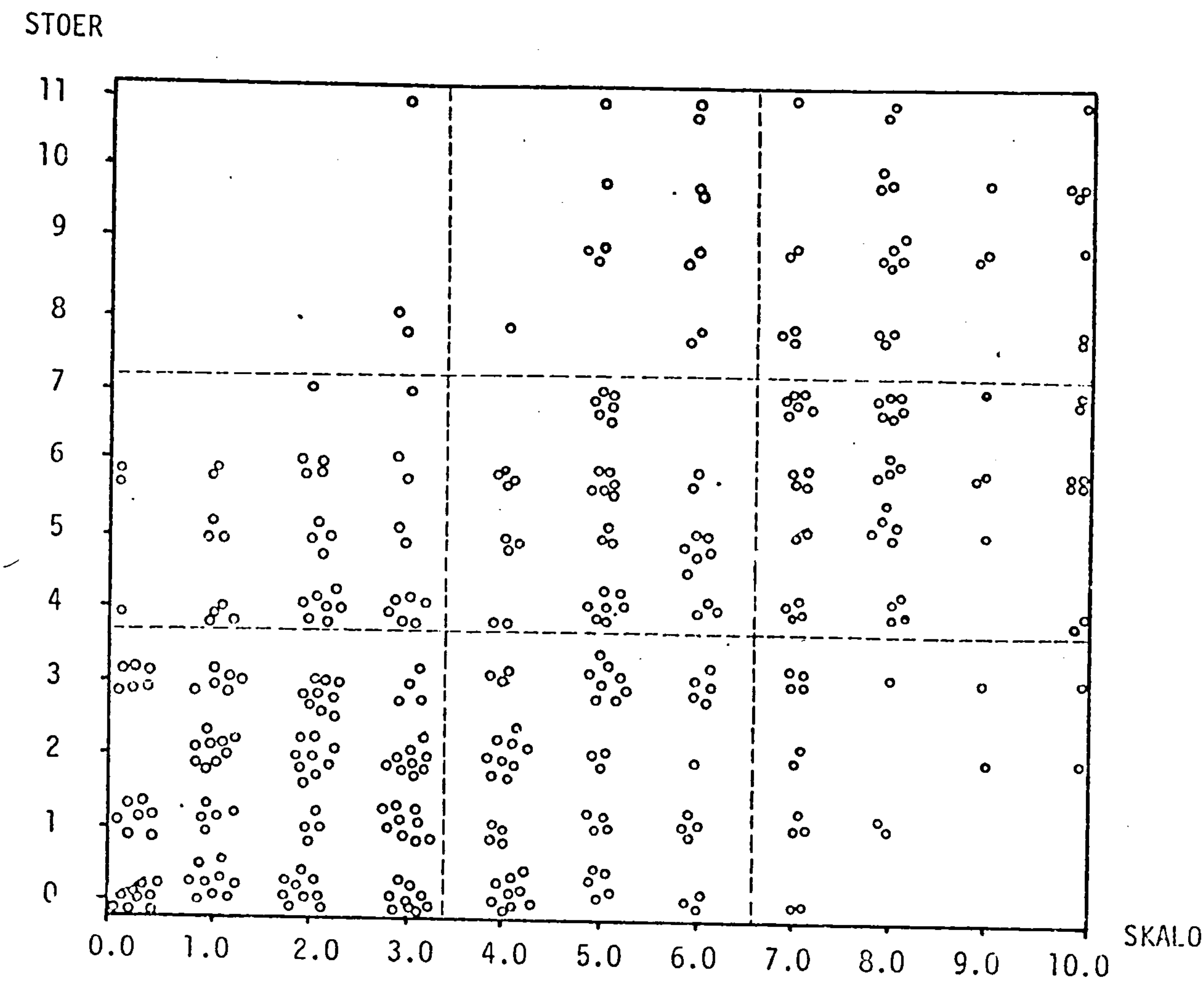


Figure 15. Dispersion diagram of the two disturbance scales

5 for "heavy disturbance.

5.4. Construction of an Acoustic Stress Standard for the Noise of General Aviation

The frequency distributions (in absolute figures and cumulated percentages) for both noise values used L_{eq} and $\overline{L}_{A\ max}$ are shown in Table 17, as they are related to the individual interview locations used in the canvassing. The close statistical relation between the two standards is visible in Figure 16.

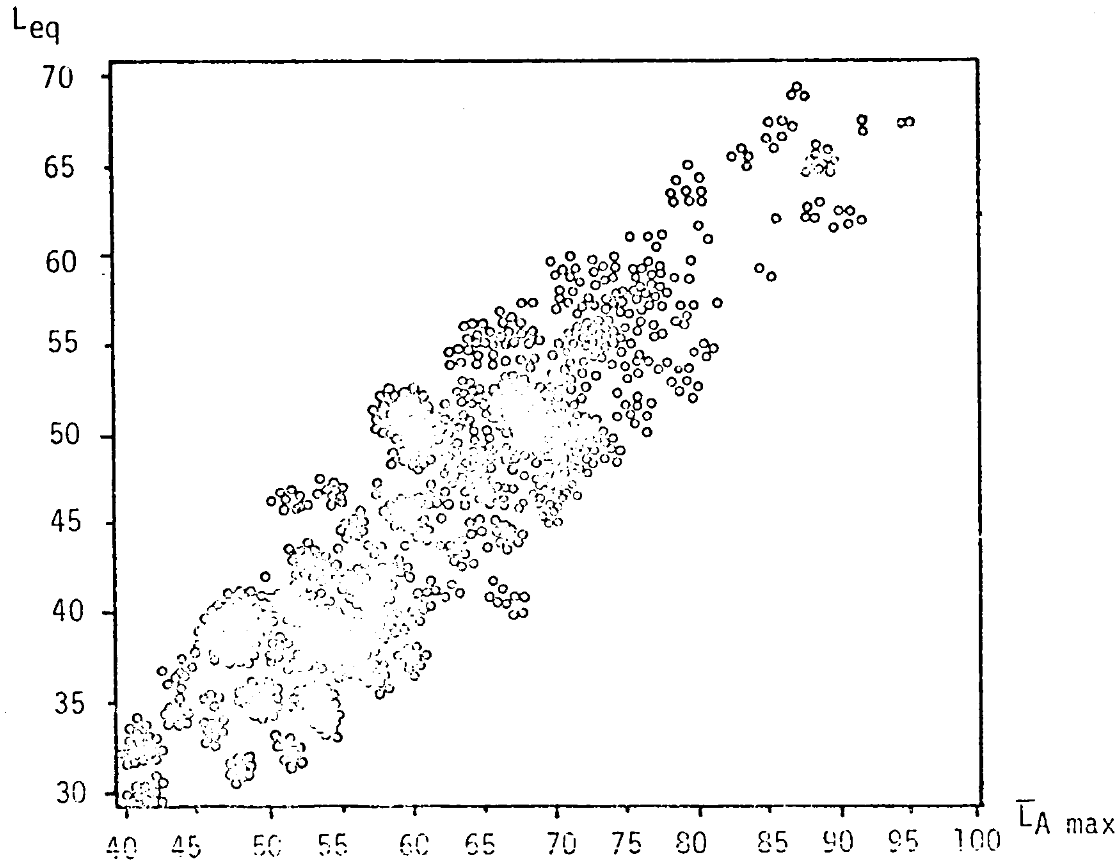


Figure 16. Dispersion diagram for the two noise standards /59

Based on a preliminary, exploratory evaluation of the statistical relationship between the noise standards and the two disturbance scales used, it seemed to be desirable to develop a combined noise standard. To be specific, it was seen that the quantity of disturbance was influenced directly by L_{eq} as well as by $\bar{L}_{Amax}$ (if the other ambient noise levels were held constant). After subsequent tests with various variations of a combined noise index, and after consultation with the coordinations group, a decision was made in favor of an index formed by simple unweighted addition of both noise standards; for enhanced interpretability of the resulting dB values,

TABLE 17: Frequency distribution of noise standards L_{eq} and $\bar{L}_{A\ max}$

/60

dB (A)	L_{eq}		$\bar{L}_{A\ max}$	
	distance	% cumulative	distance	% cumulative
30	16	1.6	-	-
31	-	1.6	-	-
32	4	2.0	-	-
33	56	7.5	-	-
34	21	9.6	-	-
35	31	12.7	-	-
36	25	15.1	-	-
37	35	18.6	-	-
38	47	23.3	-	-
39	29	26.1	-	-
40	86	34.7	16	1.6
41	9	35.5	7	2.3
42	67	42.2	31	5.3
43	8	43.0	14	6.7
44	17	44.7	-	-
45	60	50.6	8	7.5
46	31	53.7	10	8.5
47	30	56.6	3	8.8
48	25	59.1	55	14.3
49	27	61.8	40	18.2
50	92	70.9	4	18.6
51	32	74.1	3	18.9
52	85	82.5	49	23.8
53	6	83.1	54	29.1
54	23	85.3	34	32.5
55	49	90.2	40	36.4
56	12	91.4	27	39.1
57	16	93.0	14	40.5
58	5	93.5	22	42.7
59	24	95.8	38	46.4
60	4	96.2	44	50.8
61	6	96.8	22	53.0
62	2	97.0	34	56.3
63	10	98.0	22	58.5
64	-	-	21	60.6
65	-	-	41	64.1
65	12	99.2	58	70.4
67	-	-	41	74.5
68	6	99.8	10	75.4
69	2	100.0	50	80.4
70	-	-	29	83.3
71	-	-	11	84.4
72	-	-	25	86.8
73	-	-	11	87.9
74	-	-	17	89.6
75	-	-	12	90.8
76	-	-	22	93.0
77	-	-	14	94.4
78	-	-	7	95.0
79	-	-	14	96.4
80	-	-	11	97.5
81	-	-	-	-
82	-	-	-	-
83	-	-	-	-
84	-	-	4	97.9
85	-	-	1	98.0
86	-	-	1	98.1
87	-	-	5	98.6
88	-	-	4	99.0
89	-	-	8	99.8
90	-	-	-	-
91	-	-	1	99.9
92	-	-	1	100.0
TOTAL	1'010	100.0	1'010	100.0

Table 18: Frequency distribution of combined noise standard for FL.

/61

dB (A)	distance	% cumulative	dB (A)	distance	% cumulative
10	16	1.6	57	2	69.5
11	-	-	58	21	71.6
12	-	-	59	23	73.9
13	-	-	60	21	75.9
14	7	2.3	61	52	81.1
15	31	5.3	62	34	84.5
16	-	-	63	6	85.0
17	14	6.7	64	7	85.7
18	-	-	65	-	-
19	-	-	66	5	86.2
20	7	7.4	67	-	-
21	4	7.8	68	24	88.6
22	11	8.9	69	6	89.2
23	-	-	70	9	90.1
24	14	10.3	71	12	91.3
25	29	13.2	72	11	92.4
26	36	16.7	73	20	94.4
27	13	18.0	74	-	-
28	26	20.6	75	2	94.6
29	22	22.8	76	4	95.0
30	7	23.5	77	9	95.8
31	13	24.8	78	7	96.5
32	24	27.1	79	1	96.6
33	22	29.3	80	1	96.7
34	21	31.4	81	-	-
35	24	33.8	82	-	-
36	16	35.3	83	8	97.5
37	2	35.5	84	-	-
38	12	36.7	85	1	97.6
39	45	41.2	86	-	-
40	3	41.5	87	-	-
41	28	44.3	88	1	97.7
42	13	45.5	89	-	-
43	-	-	90	4	98.1
44	15	47.0	91	2	98.3
45	12	48.2	92	-	-
46	-	-	93	1	98.4
47	16	49.8	94	-	-
48	15	51.3	95	13	99.7
49	4	51.7	96	-	-
50	43	55.9	97	2	99.9
51	30	58.9	98	-	-
52	34	62.3	99	-	-
53	22	64.5	100	1	100.0
54	15	65.9			
55	3	66.3			
56	31	69.3			
			Total	1'013	100.0

this index is adjusted by a constant correction factor of -60 dB (A). Thus, the formula is:

$$FL = L_{eq} + \bar{L}_{A\,max} - 60$$

The Frequency distribution of this new noise standard is to be found in Table 18.

5.5 Statistical relationship between flight noise and subjective disturbance

Because of the special characteristic of general aviation noise, with the confirmed very steep distribution of disturbance values, it seems clear that regressional analysis is only of limited value for the representation of the relevant relationships, since this method depends on basically normal distribution of characteristics. Therefore, in the following discussion, there is no attempt made to use this method (dispersion diagram with regression lines indicated, or regression curves).

But, on the contrary, the representation form of constituent curves proved to be well suited for the representation of the results of this study. It gives clear indications if -- as was the case in this study -- the disturbance standard is characterized by pronounced dispersion. In the following pages, the constituent curves for all of the combinations which arise from /63 the three noise standards (L_{eq}, $\bar{L}_{Amax}$, and FL) are given, as well as from the two disturbance standards (SKALO and STOER, each with low or high threshhold values). This gives a total of 12 figures. The following overview dealing with the corresponding figure numbers and page numbers is intended to simplify the task of finding a particularly pertinent relationship:

CONSTITUENT CURVE / NOISE STANDARD	SKALOMETER		COMBINED DISTURBANCE SCALE	
	Greater than 4	Greater than 7	Greater than 3	Greater than 5
	Fig./Page	Fig./Page	Fig./Page	Fig./Page
L_{eq}	18a)/61	19a)/64	20a)/67	21a)/70
$\overline{L}_{A\ max}$	18b)/62	19b)/65	20b)/68	21b)/71
FL	18c)/63	19c)/66	20c)/69	21c)/72

The component curves give the percentage of interviewees, for each noise stress level measured in dB (A), who reach a value on the pertinent disturbance scale, which lies above the threshhold value; depending on the threshhold value, this corresponds to either a "middle to strong" or "strong" disturbance caused by the noise of general aviation. The calculation of all curve points is based on the method of the sliding intersection, for which a band width of $\pm$ 3 dB(A) was chosen, corresponding to the measurement tolerance of the noise calculations.

In the overview of the twelve figures, two special characteristics of the curve variations can be confirmed, which are not simply to be interpreted as an expression of the disturbance effect being studied, but as being related to the properties of /64
of the scales utilized:

- The combination curves over L_{eq} exhibit the most calm curve variation, while those over FL are the most erratic. This reflects only the fact that the span width (difference between minimum and maximum) is smallest for L_{eq} at 28 dB(A), and is highest for FL at 49 dB(A). Correspondingly, the case numbers (numbers of interviewees for each dB(A) level) on the average are substantially larger for L_{eq} than for FL. But larger case numbers mean greater stability for the curve.

- The component curves over L_{eq} and over $\overline{L}_{Amax}$ exhibit greater slopes than those over FL. This arises necessarily from the calculation formula for FL (addition of L_{eq} and $\overline{L}_{Amax}$), which leads to a stretching of the dB(A) scale to about double, and thus to correspondingly smaller slopes of the component curves.

The noticeable tendency in all curves, after reaching a maximum at the highest dB(A) range, to sink again, can on the contrary not be simply explained by the stability resulting from small case numbers, as mentioned above. Rather it is much more the case that in this range of highest noise stress -- which is equivalent to a residential location very close to an airport -- there is a systematic selection of the population which is taking place. That is to say, there is an adaptation to the noise situation: the persons living there tend to be less sensitive to the noise of flying operations.

The basic curve variation is similar for all combinations of noise and disturbance scales: a flat or weakly climbing segment in the lowest dB(A) range is followed -- in the case of L_{eq}, for example, from about 45 dB(A) -- by a first pronounced increase up to a "plateau", which interrupts the ascending branch of the curve in the range of medium loudness levels (in the case of L_{eq} about between 50 and 55 dB(A)). Subsequently there follows a second range of strong climb, after which the curve reaches its maximum; the last curve segment finally is characterized in tendency by the drop-off already mentioned.

To supplement the twelve component curves, in Table 22 the correlation coefficients for the simple linear connections between the noise and disturbance values are reproduced, and indeed for the totality of all interviewees, as well as for the individual study areas.

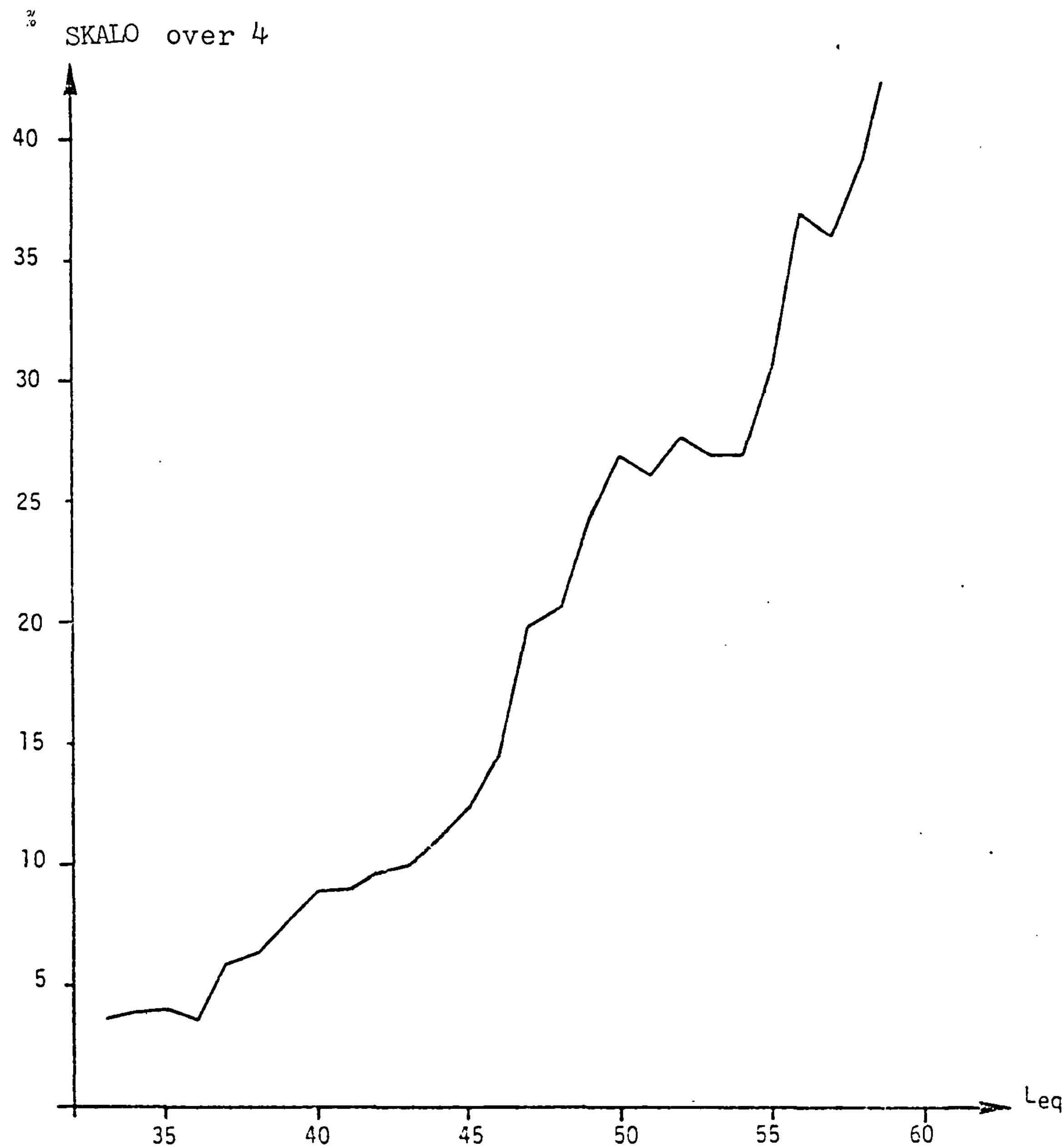


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Figure 18a): Medium and strong disturbance over L_{eq} (percentage of interviewees with values above 4 on the scalometer, for various L_{eq} values)

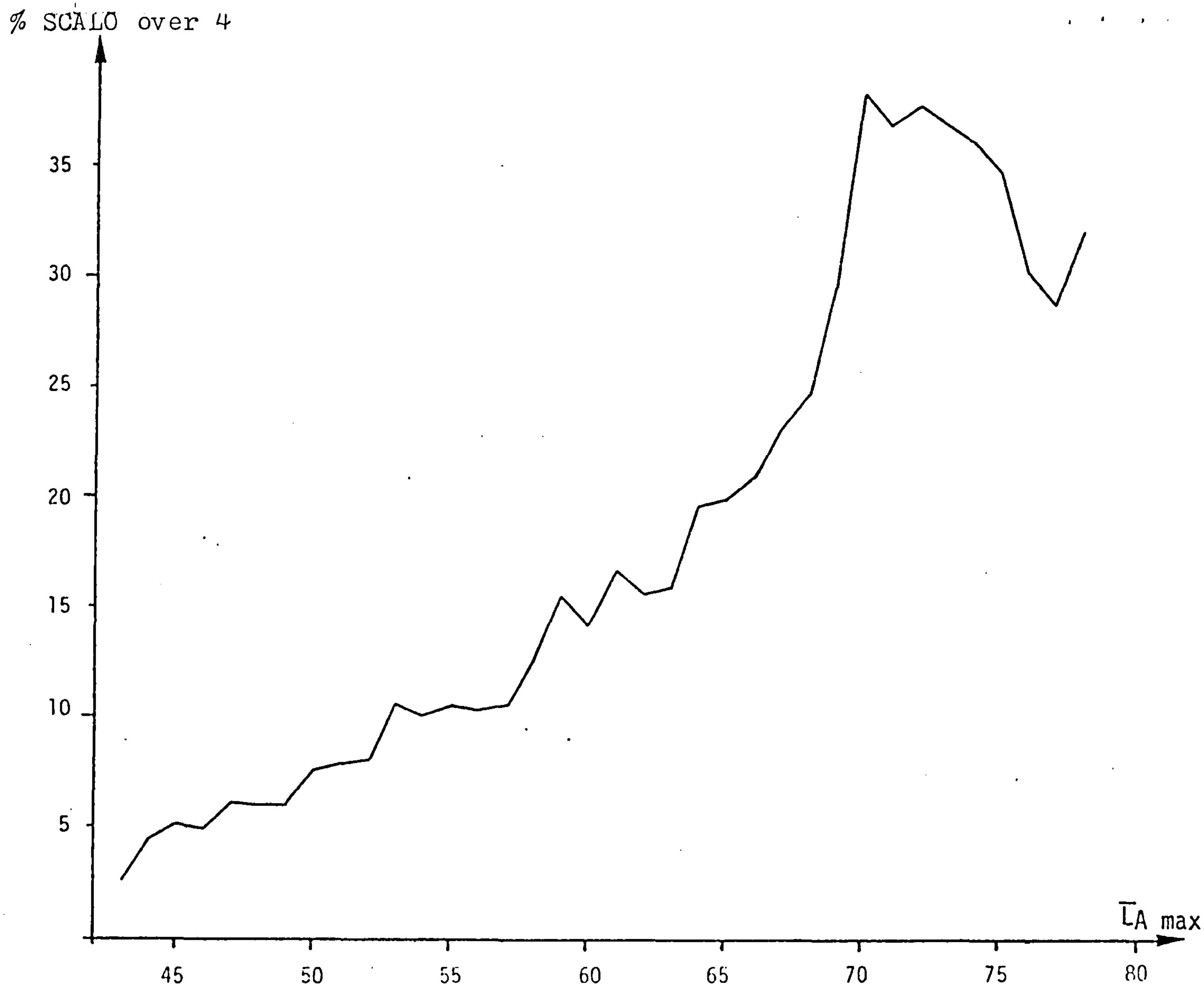


Figure 18b): Medium and strong disturbance over $\overline{L}_{A\ max}$ (percentage of interviewees with values above 4 on the scalometer for various $\overline{L}_{A\ max}$ values)

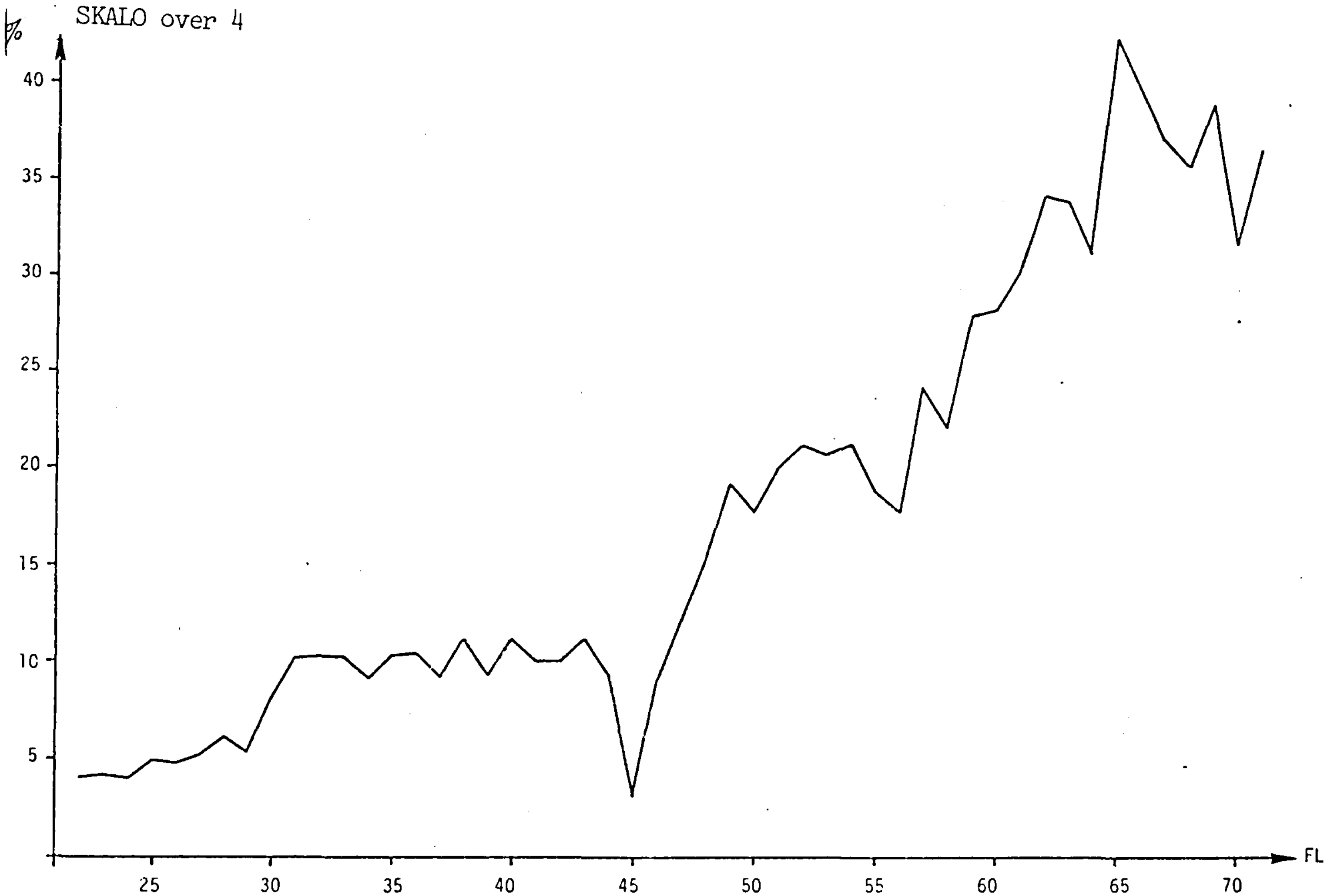


Figure 18c): Medium and strong disturbance over FL (percentage of interviewees with values of more than 4 on the Scalometer, for various FL values)

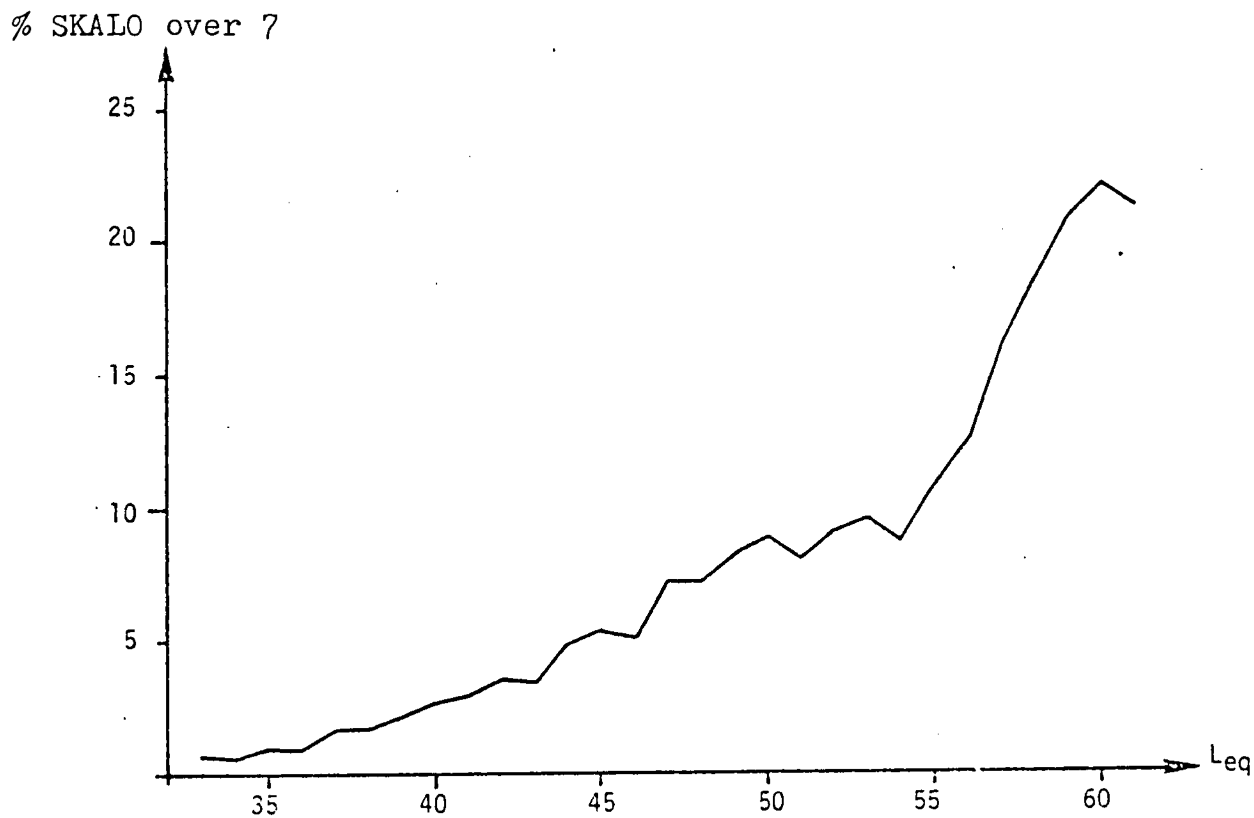


Figure 19a): Strong disturbance over L_{eq} (percentages of interviewees with values over 7 on the Scalometer for various L_{eq} values)

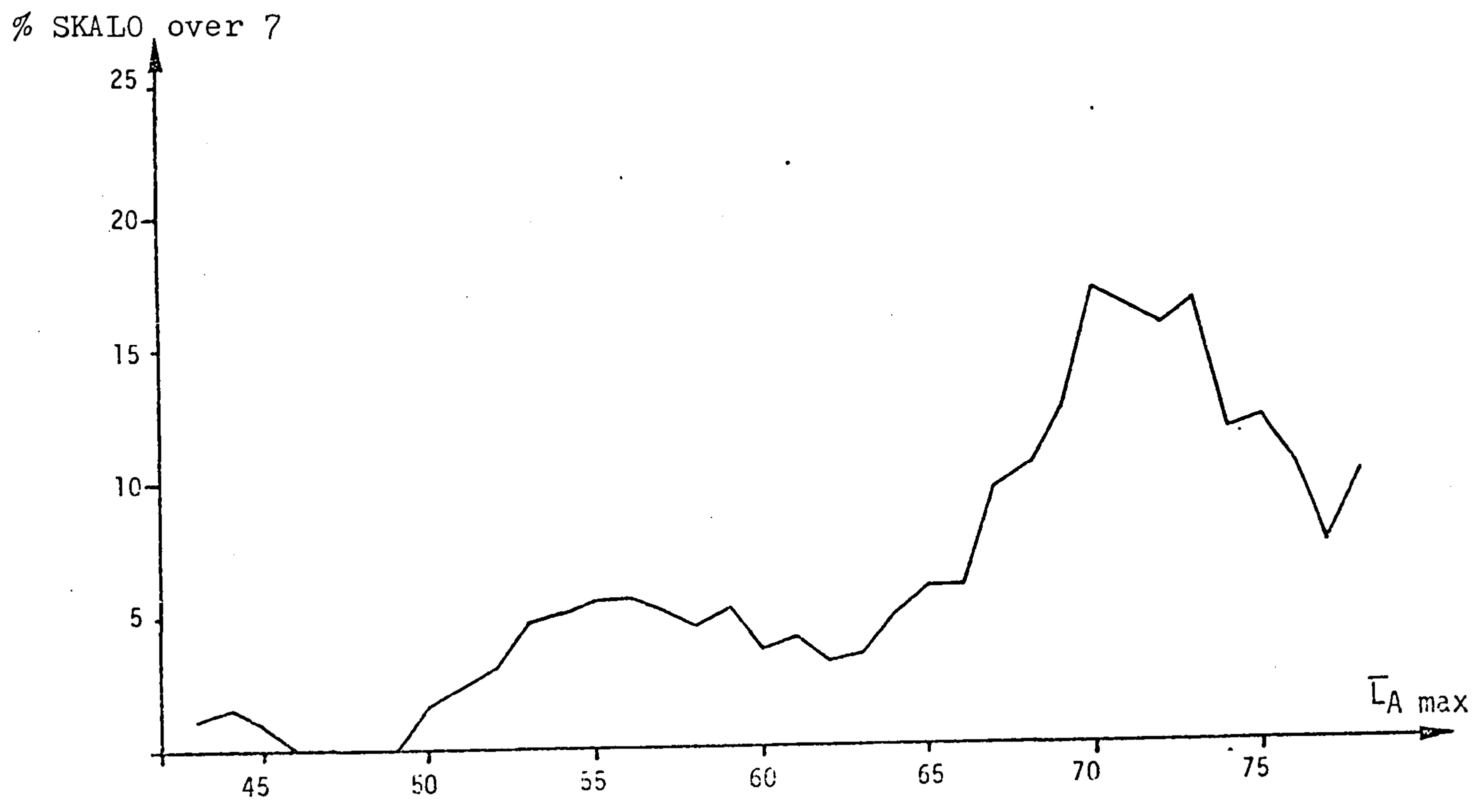


Figure 19b): Strong disturbance over $\overline{L}_{A\ max}$ (percentages of interviewees with values over 7 on scalometer for various values of $\overline{L}_{A\ max}$)

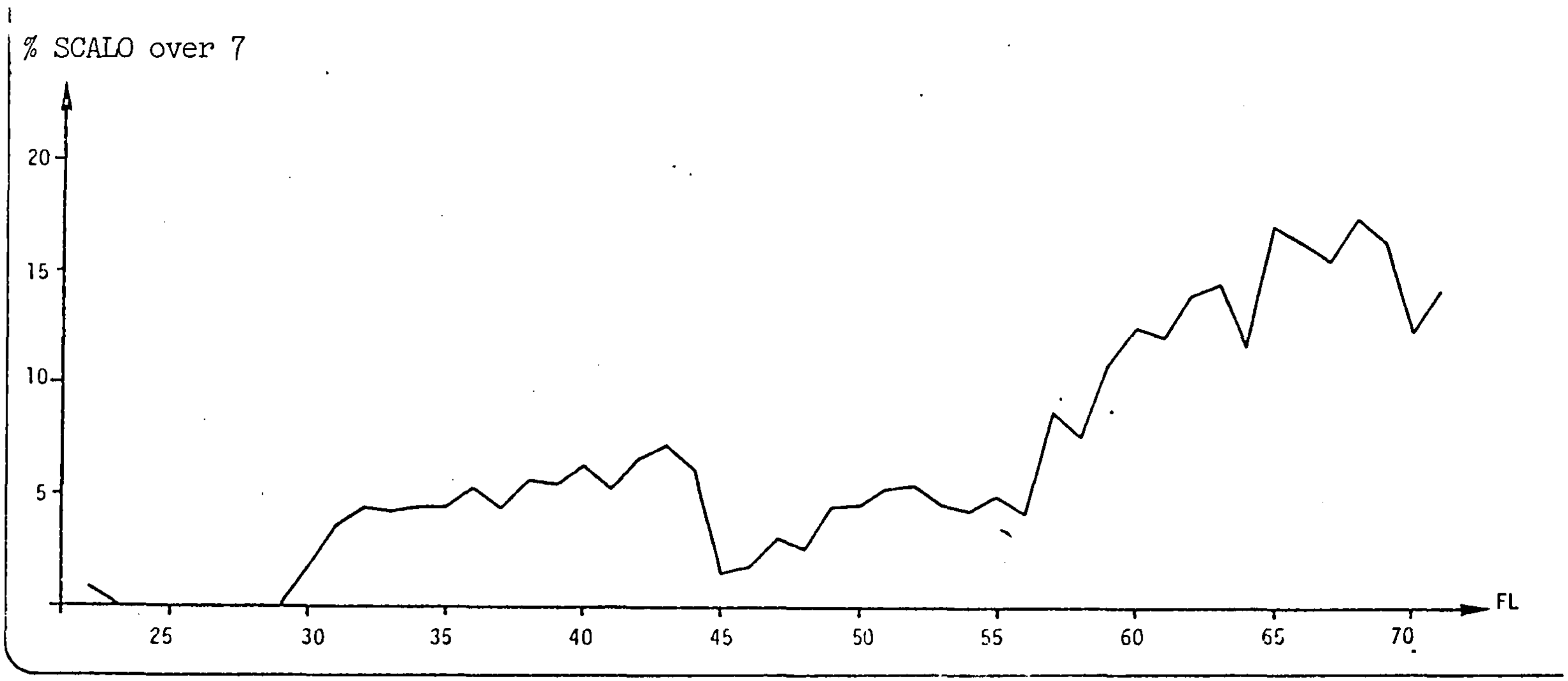


Figure 19c): Strong disturbance over FL (percentages of interviewees with values over 7 on scalometer, for various FL levels)

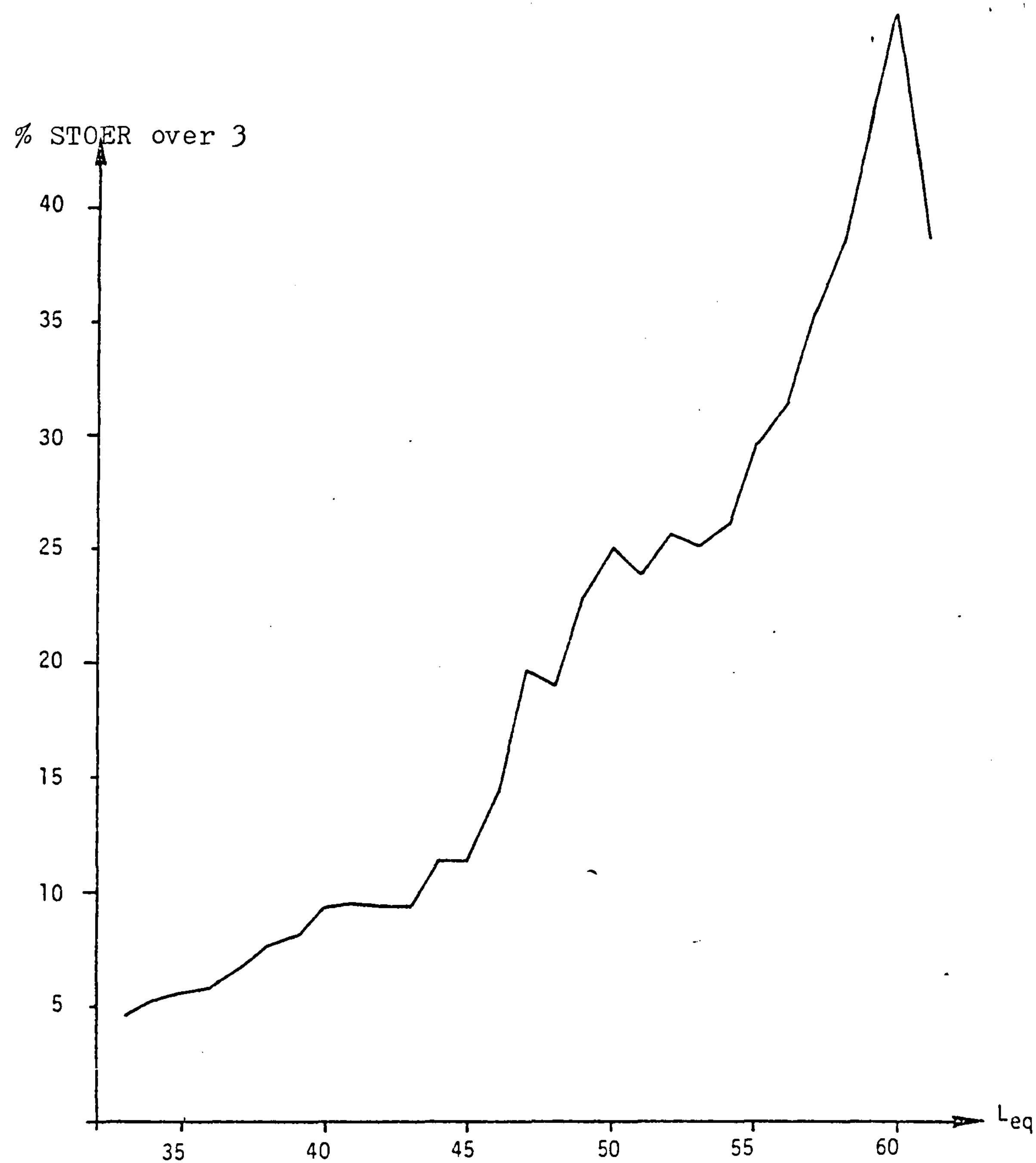


Figure 20a): Medium and strong disturbance over L_{eq} (percentage of interviewees with values of more than 3 on the combined disturbance scale, for various L_{eq} values)

/71

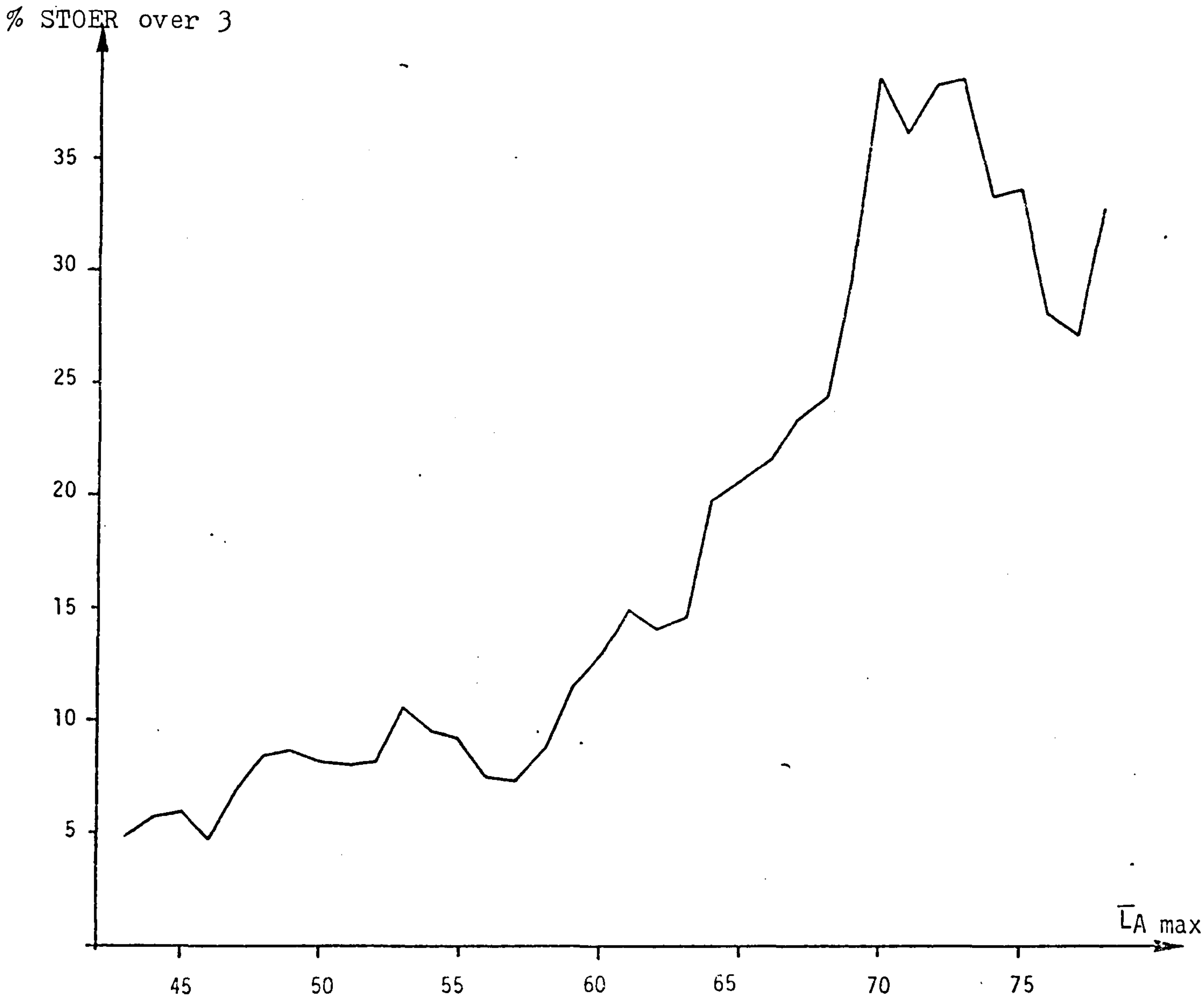


Figure 20b): Medium and strong disturbance over $\overline{L}_{A\ max}$ (percentages of interviewees with values over 3 on the combined disturbance scale, for various values of $\overline{L}_{A\ max}$)

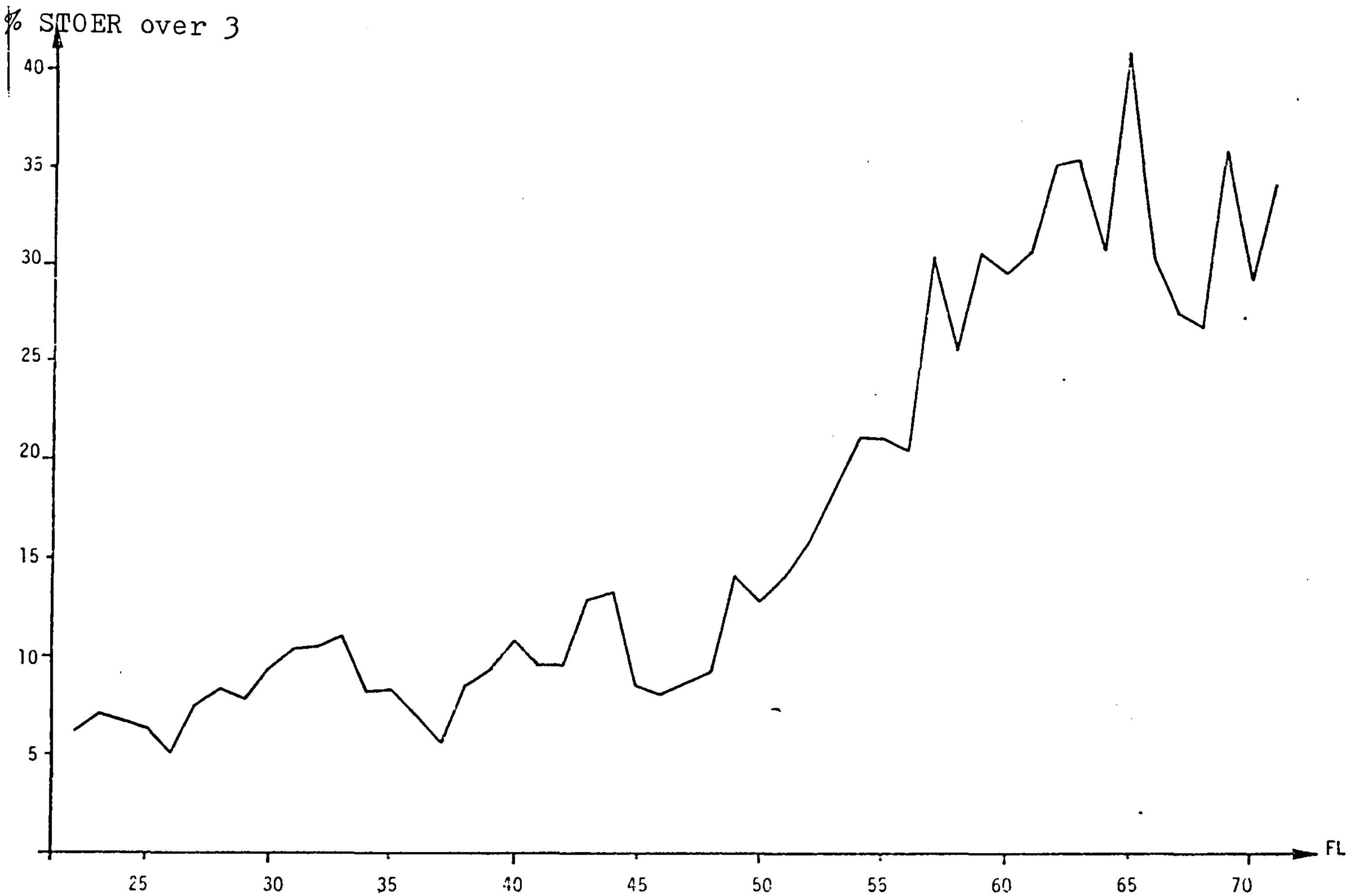


Figure 20c): Medium and strong disturbance over FL (percentage of interviewees with values over 3 on combined disturbance scale, for various values of FL)

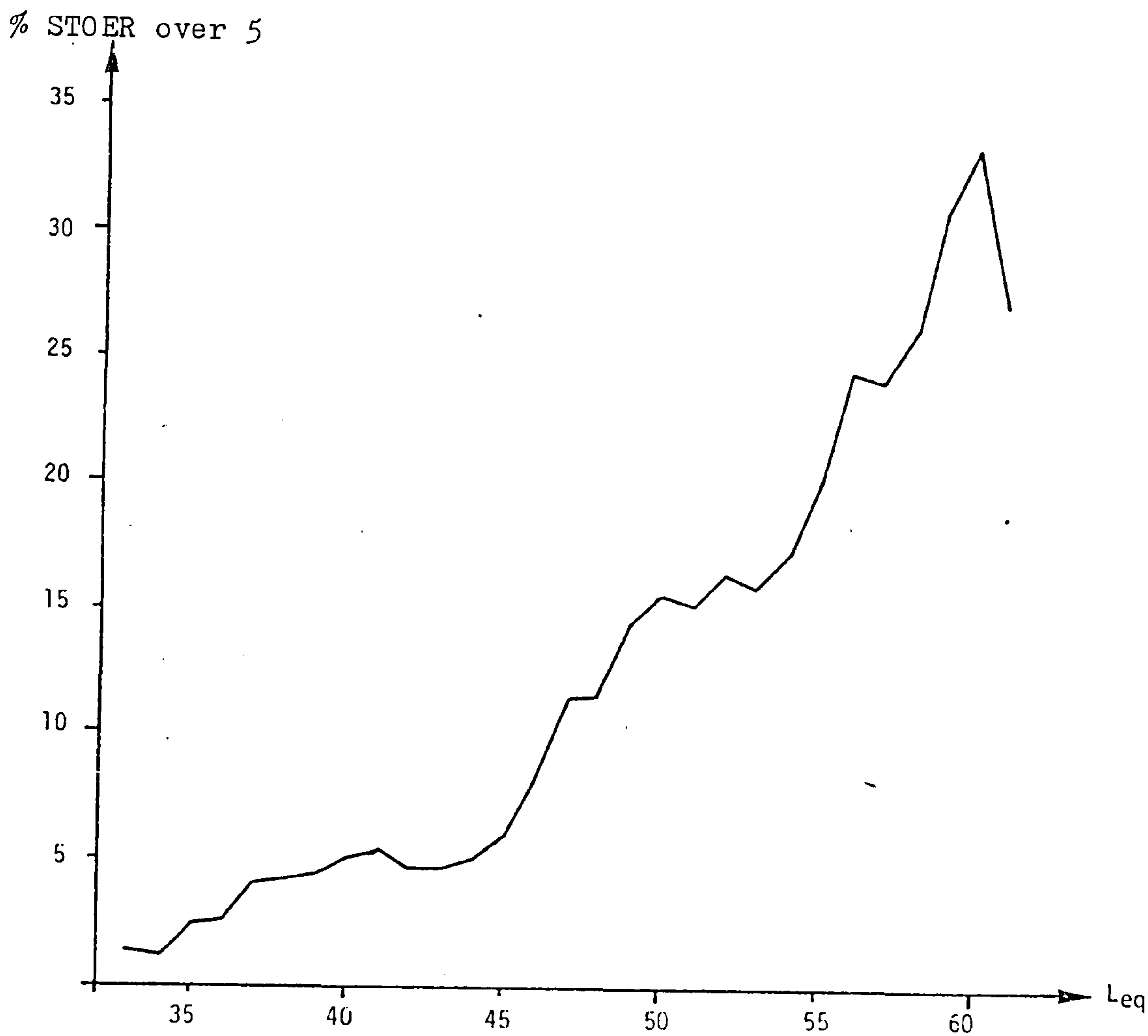


Figure 21a): Strong disturbance over L_{eq} (percentages of interviewees with values over 5 on combined disturbance scale, for various values of L_{eq})

Figure 21b): Intensity disturbance as a function of $\overline{L}_{A\ max}$ (percentage of persons surveyed with values over 5 on the combined annoyance scale for the various $\overline{L}_{A\ max}$ values)

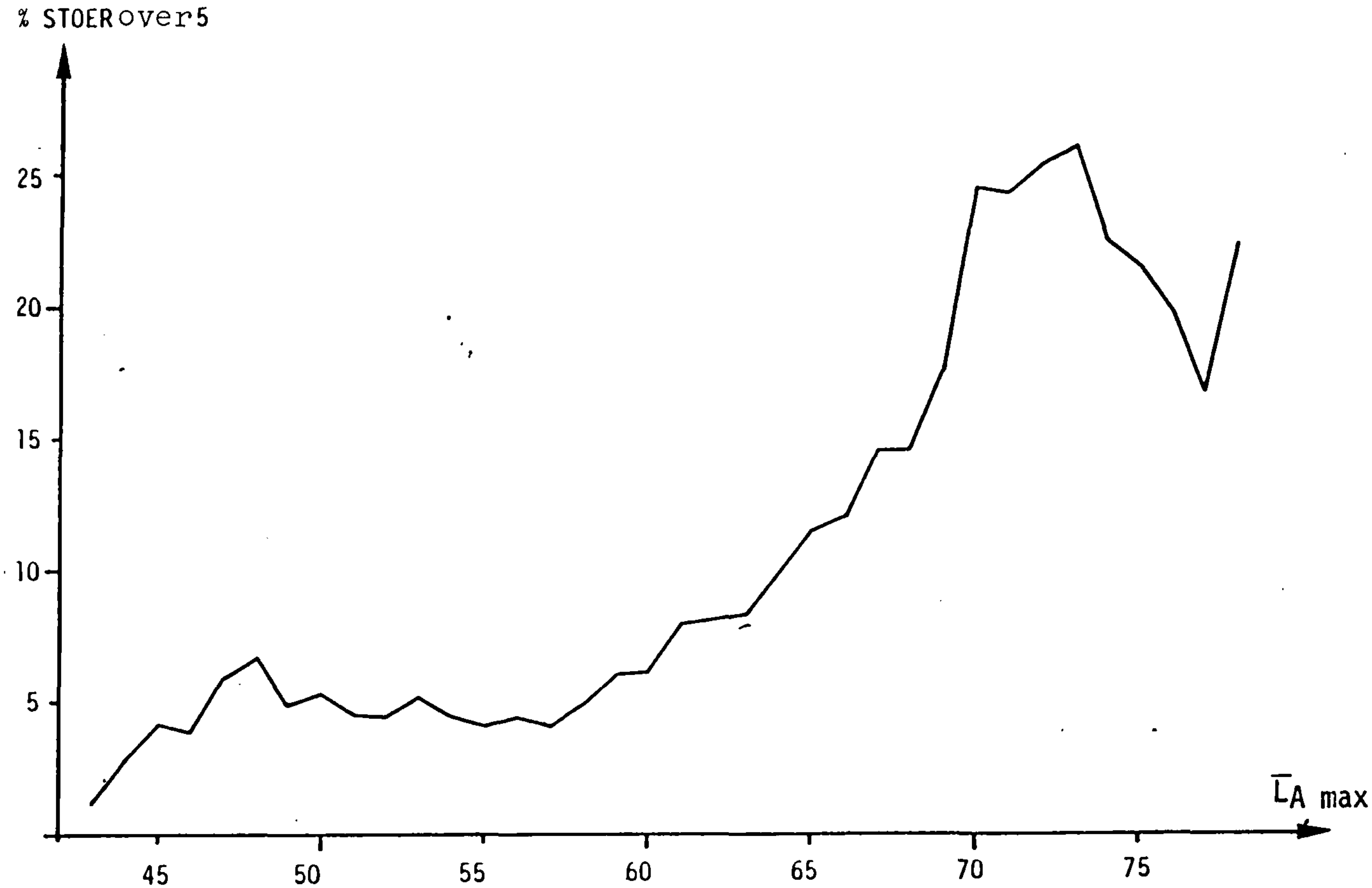


Figure 21c): Strong annoyance over FL (percentages of subjects with values over 5 on the combined annoyance scale of various FL values)

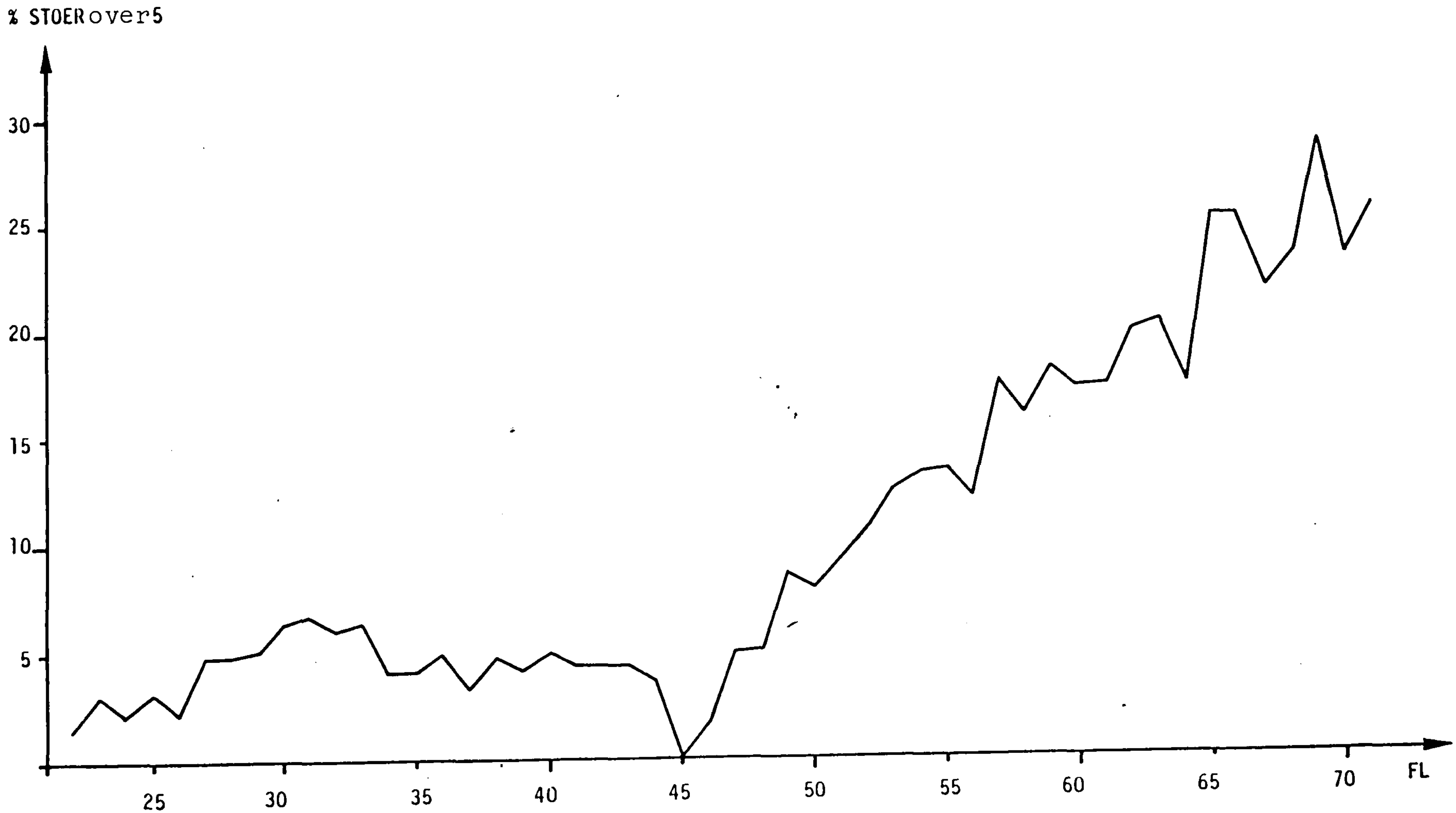


TABLE 22. Correlations between noise and disturbances

noise mask	dis-turbance mask	all subjects ($N \geq 963$)	individual investigation regions					
			BIRRFELD ($N=111$)	BERN-BELP ($N \geq 138$)	BUTTWIL ($N \geq 101$)	LUGANO-AGNO ($N \geq 330$)	LA CHAUX-DE-FONDS ($N \geq 164$)	GRUYE-RES ($N \geq 119$)
L_{eq}	SKALO	+.36	+.50	+.57	+.12	+.28	+.52	+.27
	STOER	+.28	+.48	+.59	+.19	+.13	+.33	+.38
$\overline{L}_{A\ max}$	SKALO	+.33	+.52	+.59	+.16	+.28	+.54	+.23
	STOER	+.27	+.56	+.62	+.21	+.14	+.31	+.37
FL	SKALO	+.35	+.53	+.58	+.14	+.28	+.53	+.25
	STOER	+.28	+.53	+.61	+.20	+.13	+.32	+.38

The values indicated are product-moment correlations (r). The square of this expression gives the so-called certainty measure r^2, which defines the fraction of the variants explained by each noise measure of each disturbance measure. With the exception of the region Buttwil, all of the correlation relationships are highly statistically significant*.

5.6. Influence of the surrounding noise and other factors on the relationship between aircraft noise and disturbance due to aircraft noise

In this section we will discuss the possible influencing variables which can explain the special characteristics of the relationship between the noise measure and the disturbance measure

*The error probability p in most cases is 0.000. Excpetions: In the region Lugano-Agno, p for the relationships with STOER = 0.010, and in the Gruyeres region for the relationships with SKALO=.007. For the Buttwil region, in the relationships with STOER we have p=0.025 and for the relationships with SKALO we have =0.125.

in partial groups of particular interest.

In order to conserve the comparability, this discussion will be restricted to a single combination of noise measure and disturbance measure, that is, between the noise measure FL and the disturbance scale STOER. /78

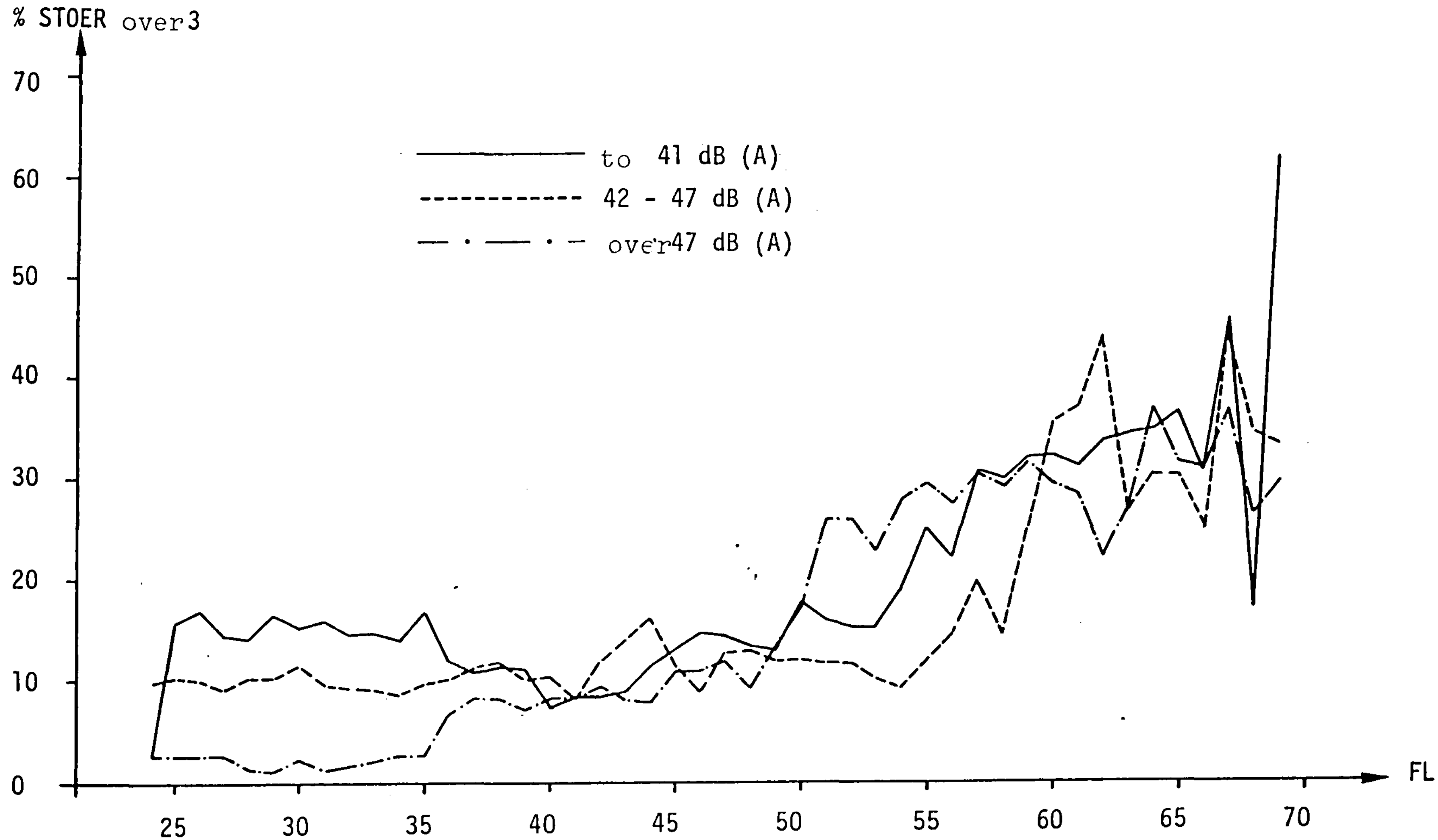
5.6.1. Influence of the surrounding noise

Figure 23 (see next page) shows the fraction curves for STOER (with special value 3) plotted as a function of FL for 3 partial groups which have different surrounding noise environment. The 3 surrounding noise regions are defined so that about 1/3 of the random sample corresponds to each value range (low, average or high surrounding noise). In units of dB (A) three classes are specified as follows: up to 41 dB (A) = (relative) lower, 42-47 dB (A) = average surrounding noise and above 47 dB (A) = (relative) high surrounding noise. In order to limit the effects of dividing the sample into 3 caused by the reduction in the number of cases (discontinuous curve variation), here the calculations for the curve points are based on a band width of ±5 dB (A).

The variation of the three curves clearly shows what was already to be expected from earlier results: the surrounding noise environment influences the relationship between flight noise disturbance less from a quantitative point of view, but instead determines the relationship between these parameters. In other words, depending on the extent of the surrounding noise, the variation of the curve between flight noise and flight noise disturbance changes. Based on the present data, it seems to make sense regarding the characteristic of the investigated relationships, to distinguish 4 different value ranges on the FL scale:

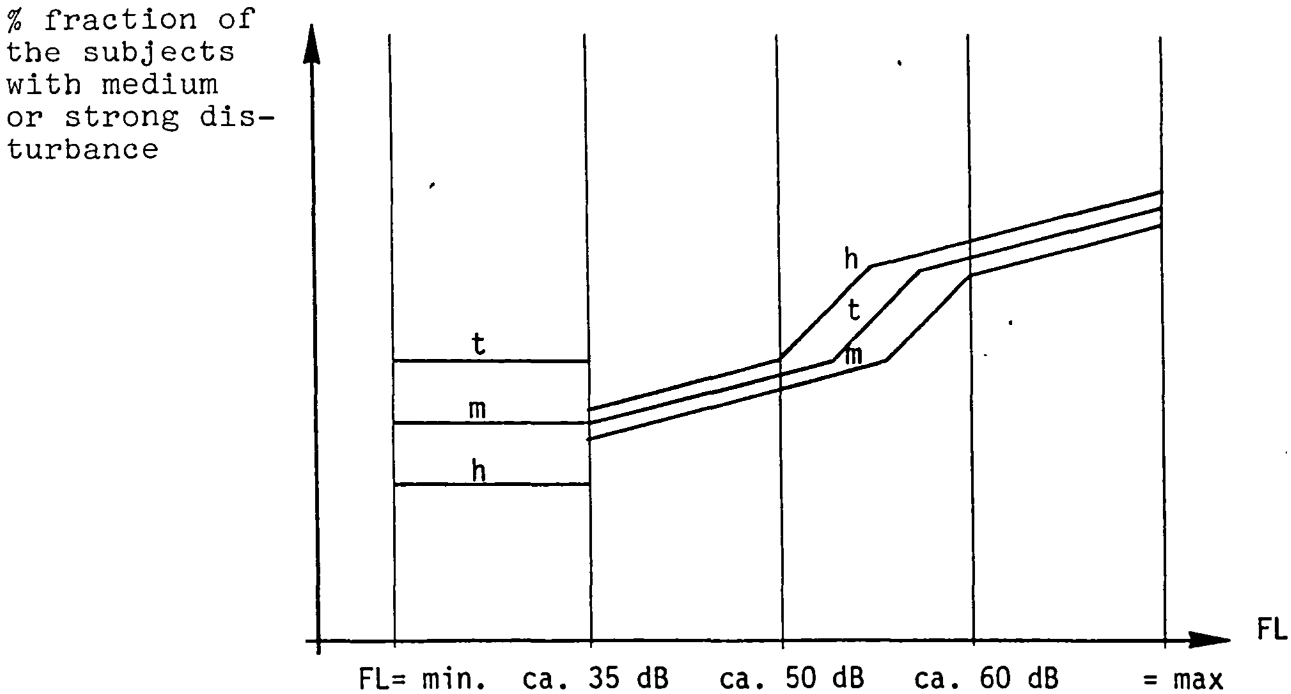
- FL below about 35 dB (A): very low flight noise disturbs (relatively) more the less surrounding noises present.

FIGURE 23: Average/strong disturbance (STOER) according to surrounding noise as a function of FL



- FL = about 35-50 dB (A): in this value range, a very slight increase in the fraction of disturbed persons is observed as flight noise increases. The surrounding noise plays another role.
- FL = about 50-60 dB (A): this value range includes the most interesting region of large inclination of interest for the limit value discussions for all 3 curves. The 3 curves, however, are not parallel. The region of large inclination extends to the value range between 48 and 51 dB for high surrounding noise. For low surrounding noise, it extends in the range between 53 and 57 dB. For average surrounding noise, it covers the range between 54 and about 60 dB. /80
- FL = above about 60 dB (A): with a very unsteady curve variation (because of low number of cases), in this value range we cannot find any systematic difference with respect to surrounding noise. An increase in the flight noise above the 60 dB level does not cause any increase in the fraction of disturbed persons. (Possible reason: selection of the "insensitive ones").

Following is a schematic simplification of the three curves:



The correlation coefficients for the relationship STOER/FL for a low surrounding noise is + .41, for medium surrounding noise +.28 and for high surrounding noise +.35. These numbers show that the relationship between flight noise and disturbance is relatively weak if the surrounding noise is held constant as a boundary condition. /81

If instead of the measured effect of surrounding noise we introduce the subjected disturbance by different types of surrounding noise as the boundary condition, we find a more unified picture: (See table 24).

On the one hand, we can see that the relationship between aircraft noise and aircraft noise disturbance with consideration of the subjectively sent surrounding noise is greater than if one considers the objectively measured one. We also find that this relationship apparently is the strongest in those persons which interpret a high surrounding noise as the sum of several noise sources.

TABLE 24: Correlation for STOER/FL according to subjective disturbance by surrounding noise

boundary condition		correlation for the corresponding partial sample (r)
characteristics	value range	
disturbance due to street noise	scalometer values below 3 scalometer values above 5	+.22 +.37
disturbance by train noise	scalometer values under 3 scalometer values over 5	+.26 +.48
disturbance due to street noise and train noise	both scalometer values below 3 both scalometer values above 5	+.23 +.48
general estimate of the residents surroundings in the polarity profile (dimension "quiet-noisy" as scale with values from 1 to 6)	classification as quiet (Scale value 1) classification as noisy (Scale values 5 or 6)	+.16 +.52

5.6.2. Other influencing factors /82

In addition to distinguishing between the surrounding noise environment, we introduced a number of other factors as test characteristics. The subgroups defined in this way were investigated whether and to what extent the FL/STOER correlations deviate from the corresponding value of 0.28 as was found for the entire random sample. As a criterion for a deviation considered to be significant in the correlation coefficient of the partial random sample from that of the total random sample, we used the certainty measure r^2. The correlation is then called significantly "weaker" (in the mentioned sense) if the declared variance ($=r^2$) is at least cut in half compared with the total random sample. It is called significantly stronger if it is at least doubled. When the variance is cut in half, this corresponds to a correlation coefficient of $r = 0.20$ and a doubling corresponds to a coefficient of $r = 0.40$.

Accordingly, greater correlation coefficients were found for the following groups compared with the total random samples:

	r	N	p	question
- subjects which had partipated in rallies against the close airport	0.45	78	0.000	72
- subjects which had earlier used the airport as a point of departure for a pleasure flight	0.48	154	0.000	83
- subjects which liked their location better before compared with today	0.49	162	0.000	4
- subjects which are farmers or whose head of household is a farmer	0.50	78	0.000	18 /83
- subjects which prefer to spend their free time outside of their location or village	0.52	33	0.001	28

	r	N	p	question
- subjects whose workplace is as noisy or noisier compared with their residence	0.65	12	0.011	19/20

For the following partial groups, correlations were found whose intensity were below that of the average correlation coefficients:

	r	N	p	question*
- subjects who themselves are employees or they are head of households	0.20	266	0.001	18
- subjects which are not most disturbed in their living rooms, bedrooms or childrens rooms, but in another room (workroom, dining room, etc).	0.20	69	0.048	66
- subjects which live on the 5th floor or higher	0.19	38	122	111
- subjects whose net household income per month is about 4000 Swiss francs	0.19	119	0.021	21
- subjects which consider that aviation is legitimate at their close airport (that is, all of the operating modes are reasonable)	0.14	222	0.017	81
- subjects which are active in a village having an industrial, business-character	0.06	74	0.296	IV

We would like to recall the fact that high values of r only /84 mean that if the noise increases, the extent of the disturbance will also increase and vice versa. The correlation only expresses to what extent the relationship between noise measure and disturbance measure exists. However, nothing is said about the extent of

*Roman numbers refer to the interview protocal at the end of the questionnaire.

the disturbance.

When applied to the partial groups mentioned above, the correlation coefficients could be called a measure for the rationality of the disturbance reaction. Thus, the groups of the first block (high correlation) are characterized by a high degree of rationality, because an increase noise level for them means an increase in disturbance. In the second block (low correlation), we hardly have any systematic relationship.

6. Interpretation of results and consequences /85

In Chapter 5, we restricted ourselves to a description of the evaluation results which could result during the evaluations. Since we now can have an overall view, we will attempt to give a summary interpretation of our investigation results and draw some consequences to the extent that they are allowable based on our data.

1. The noise called by minor aviation is not perceived as the dominant disturbance source except for the immediate vicinity of the airport. Massive disturbing symptoms (which exist for noise in the surroundings of large airports or along intensely driven roads) can, therefore, not be detected.

2. On the other hand, the space distribution of the aircraft noise is not limited much. Only about 40% of our subjects within our integration region (referred to the calculated L_{eq} curves somewhat generous) do not hear any noise at all from aircraft. It is one feature of small aircraft noise that it can be encountered everywhere and also in areas which otherwise do not have noise. This is a consequence of the fact that the (Volten = misprint?) are usually situated in uninhabited regions in order to protect residential zones.

3. From the two aspects mentioned above (no dominance but large space distribution), aircraft noise is similar to road noise which is typical for the investigated regions. (Only moderate traffic on main roads). This may also explain the fact why the aircraft noise is classified just after road noise with respect to a number of characteristics (for example, frequency of perception, disturbance effect, influence of life quality).

4. In contrast to this, small aviation noise clearly is different from road noise (and also other kinds of noise) in terms of its occurrence over time. With some exceptions (for example, rescue flights), it does not occur at night. On the other hand, there is a very pronounced concentration during certain seasons, days and times of day. The special times associated with aircraft noise (accumulative during the early afternoon of the weekends during the summer), we also have the times where the population is most exposed to the noise (outside activity, open windows). On weekends and during the summer holidays, an increased recuperation requirement and rest requirement may play a role here. /86

5. The space and time aspects of aircraft noise and its disturbance lead to the assumption that the aspects of type mix, operating times and flight path position or maintenance of them by the pilots, not considered in our investigation, could be just as important for our disturbance effect as the noise level load measured in decibels.

6. Conversely, we do not believe that the small aircraft noise will be sent as disturbing because of the noise development but also because potentially noise free regions or times are additionally loaded with noise. We have to consider here that from a global point of view, which goes beyond the airport regions we investigated, we have to assume that the contribution of small aviation to the reduction of truly noise free regions is exceptionally high in our country.

7. The previous discussion indicates that when objective noise is converted into a subjective disturbance, there is a factor which could play a very decise role, the factor of the expected level of the environment. Such a factor could also explain the fact that the correlations between noise measures and disturbance levels are very different depending on the region investigated. The correlation coefficients there are very high (or reach a level which normally is only attributed to strong noise types), where also the preloading by other noise sources is already high. This is in the urban and industrial regions of La Chaux-de-Fonds and also Birrfeld and Bern-Belp. /87

8. If one orders the investigation regions based on the average intensity of the correlation coefficients for the various combination of noise and disturbance measures, then this order for the most part corresponds to the order which corresponds to the movement at the airports with two exceptions Lugano-Agno and Buttwil (see below). In addition to the general preloading, therefore, the loading of a region by the number of flights also seems to be a factor which influences the relationship between the noise level and the disturbance.

9. In other words: The airports specific correlation results indicate that the minor aviation noise is converted into a disturbance in a somewhat systematic way if certain boundary conditions are present (this is expressed by the high correlation coefficients). These boundary conditions include the general preloading within a region by other noise sources, the importance of the airport in the sense of traffic density and (not independent of these two factors), the general expectation of the population. It is only when these conditions are present to a certain extent (for example, in the sense of a critical mass), does minor aviation noise cease to be a disturbance as an individual problem and becomes more and more a social problem. It is only then that one finds a social definition of this kind of noise or the related

disturbance effect. This then leads to clear statistical relationships (correlations) between noise measures and disturbance measures.

10. The concept of the social definition of noise and the corresponding disturbance effect could explain the fact why for the region Buttwil, we only found very small correlation coefficients. It is possible that the conflicts among the population about this airport could have led to the acceptance of a social definition in this region according to which the noises these aircraft are looked upon as being disturbing for every case, that is independent of the traffic and the noise level. Therefore, low correlation coefficients were the result of such a mechanism. /88

Independent of this, in Butwill military aircraft carry out regular maneuvers in this region and apparently they are related to large disturbances greater than those of small aviation. The superposition of these two types of noise has also been precipitated in the interrogation results.

11. For the second exception case Lugano-Agno, we find a similar mechanism but with the reverse sign: The boundary condition of the Tessins leads to the fact that this airport is given a relatively positive evaluation because of its conveyance function to the centers (especially Geneva, Zurich and Milan). This then leads to the fact that the disturbance effect is classified as small (because of the mechanism of the social definition of the disturbance effect of noise), and this occurs independent of the real noise situation.

12. The preconditions mentioned have a quantitative and a qualitative effect on the statistical relationship between noise level and the disturbance (general noise situation, operating characteristics of the airport, expectations of the environment, rationality of noise evaluation, etc.). This can be seen from

the fact that it is not a certain kind of disturbance measure which can be called better: For the regions Buttwil and Gruyeres, we find a combined disturbance scale. For the Lugano-Agno and for La Chaux-de-Fonds, the scalometer gives the better correlation coefficients. For Birrfeld and Bern-Belp, there is no clear tendency to be found. These differences can be interpreted as /89
an indication for a further influencing factor, which would be considered rural-urban and is related to a cultural dimension.

13. If in addition to these suspected factors (boundary conditions), the cultural language factor is also important (in the sense of a culture specific to the parts of the country), can not be decided based on this investigation. Certainly, the language is an important aspect of the culture and the way in which noise disturbance is defined socially. Clear difference between the regions of the country, however, cannot be verified based on our results.

14. Overall, the present results show that the conversion of noise into a subjective disturbance for small aircraft can only be done in a somehwat systematic way (and also be forecast if certain boundary conditions are met). At the same time we can see that over all the relationship between noise and disturbance is relatively small. However, when these preconditions appear accumulatively, the statistical relationship reaches a level which does allow a comparison with other noise types. However, based on our results, we cannot give any detailed information about the various factors and how they have a qualitative and quantitative effect on the statistical relationships between the noise and the disturbance. An exact clarification of this can only be done with additional evaluation steps, an intensive analysis of each airport and by using multivariate and other methods.

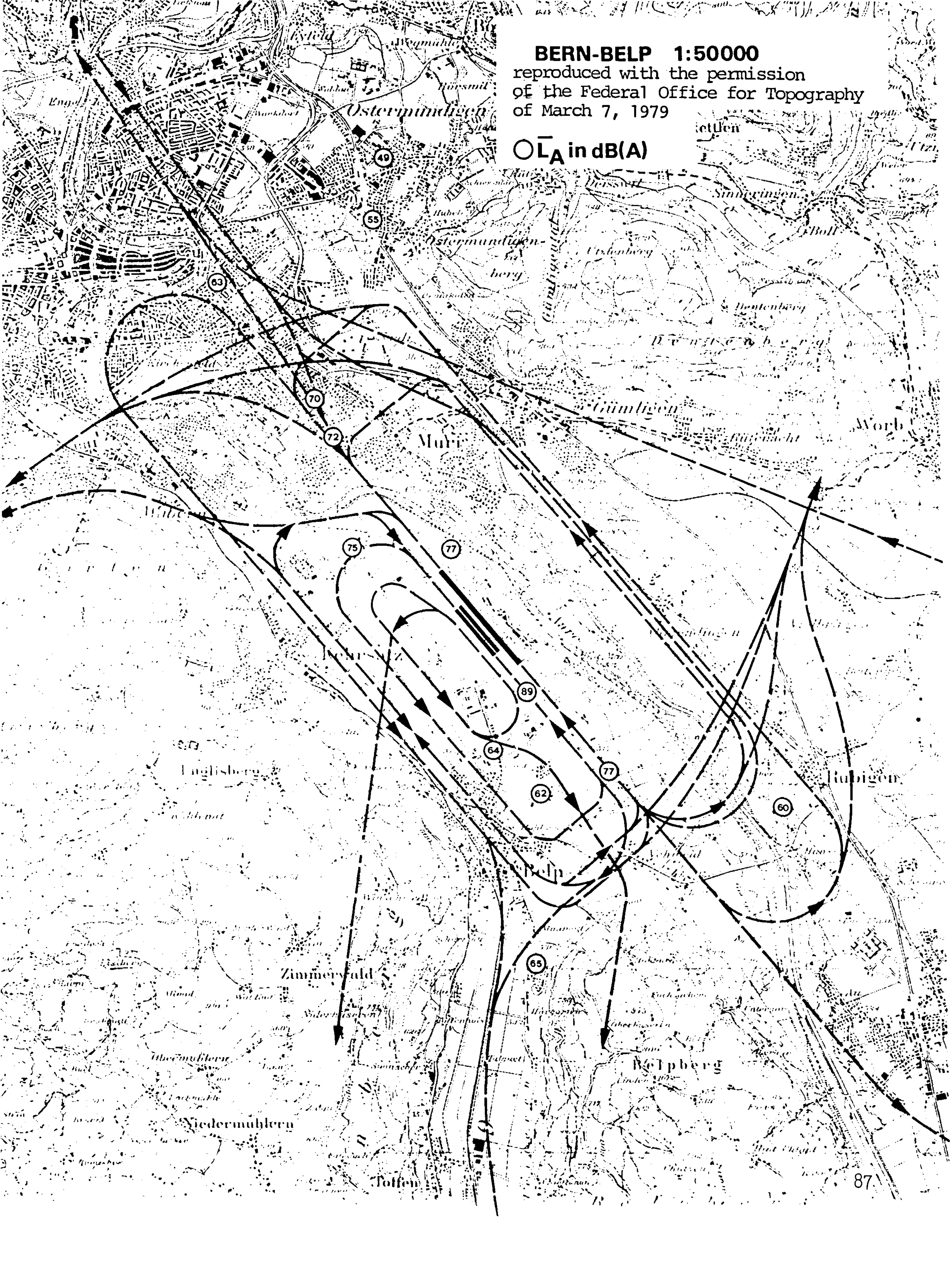
APPENDIX I

MAPS OF THE INVESTIGATED REGIONS

Two maps are given for each region. The first contains the curves of equal L_{eq} values and the second contains the $\overline{L}_{A\ max}$ values for selected points. Both maps indicate the flight paths using dashed lines.

The investigation regions appear in the following order:

- Bern-Belp
- Birrfeld
- Buttwil
- La Chaux-de-Fonds
- Gruyeres
- Lugano-Agno


BERN-BELP 1:50000
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of March 7, 1979
$\bar{L}_A$ in dB(A)
49
55
63
70
72
75
77
89
64
62
77
60
65
Ostermundigen
Gümligen
Muri
Worb
Rubigen
Belp
Englisberg
Zimmerwald
Niedermuhlern
Belpberg
Toffen


BERN-BELP 1:50000
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Leq in dB(A)
40
45
50
55
60
Muri
Gümligen
Worb
Rubigen
Ostermundigen
Belpberg
Niedermuhlern
Toffen

BIRRFELD 1:50000

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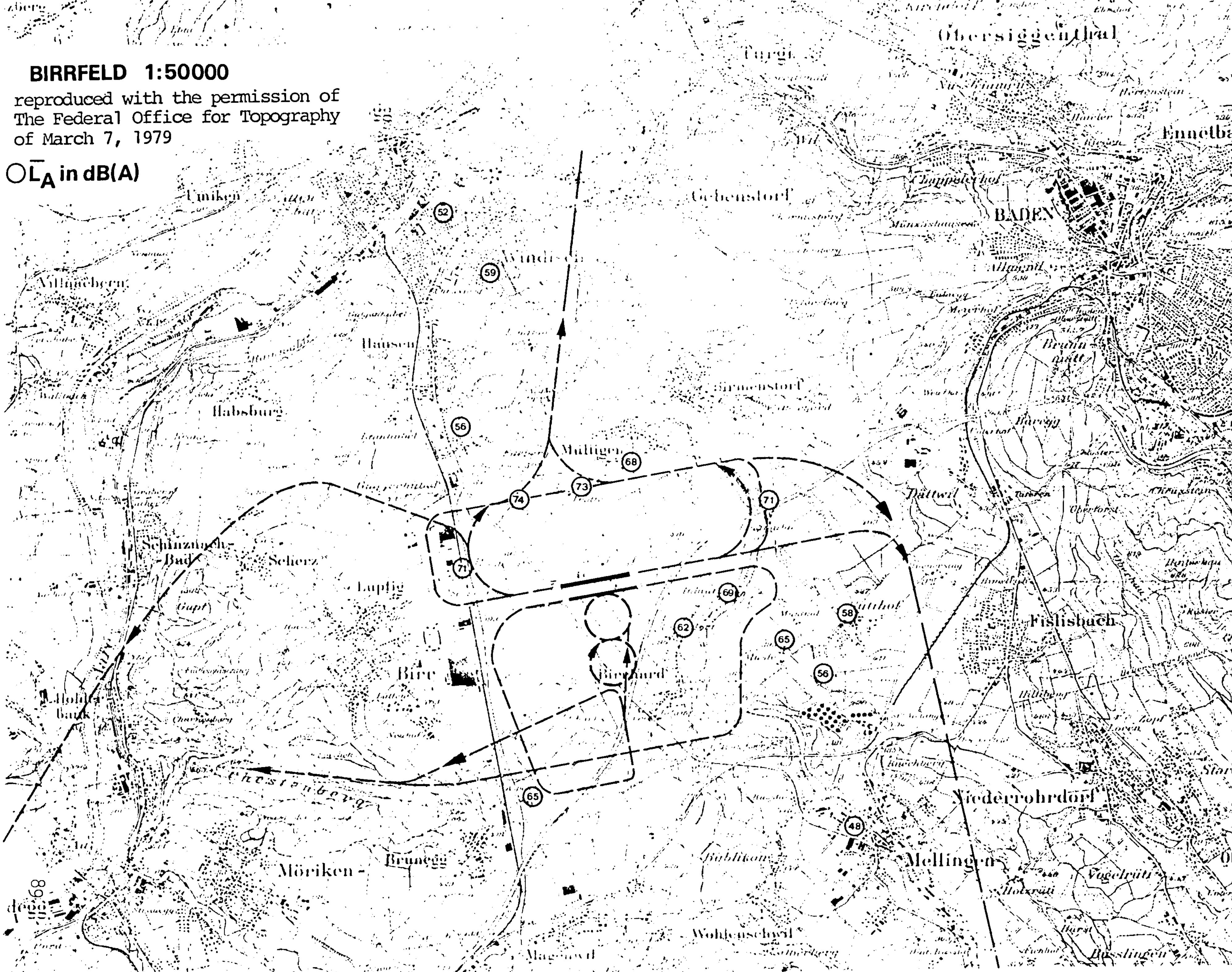
○ $\overline{L}_A$ in dB(A)



BIRRFELD 1:50000

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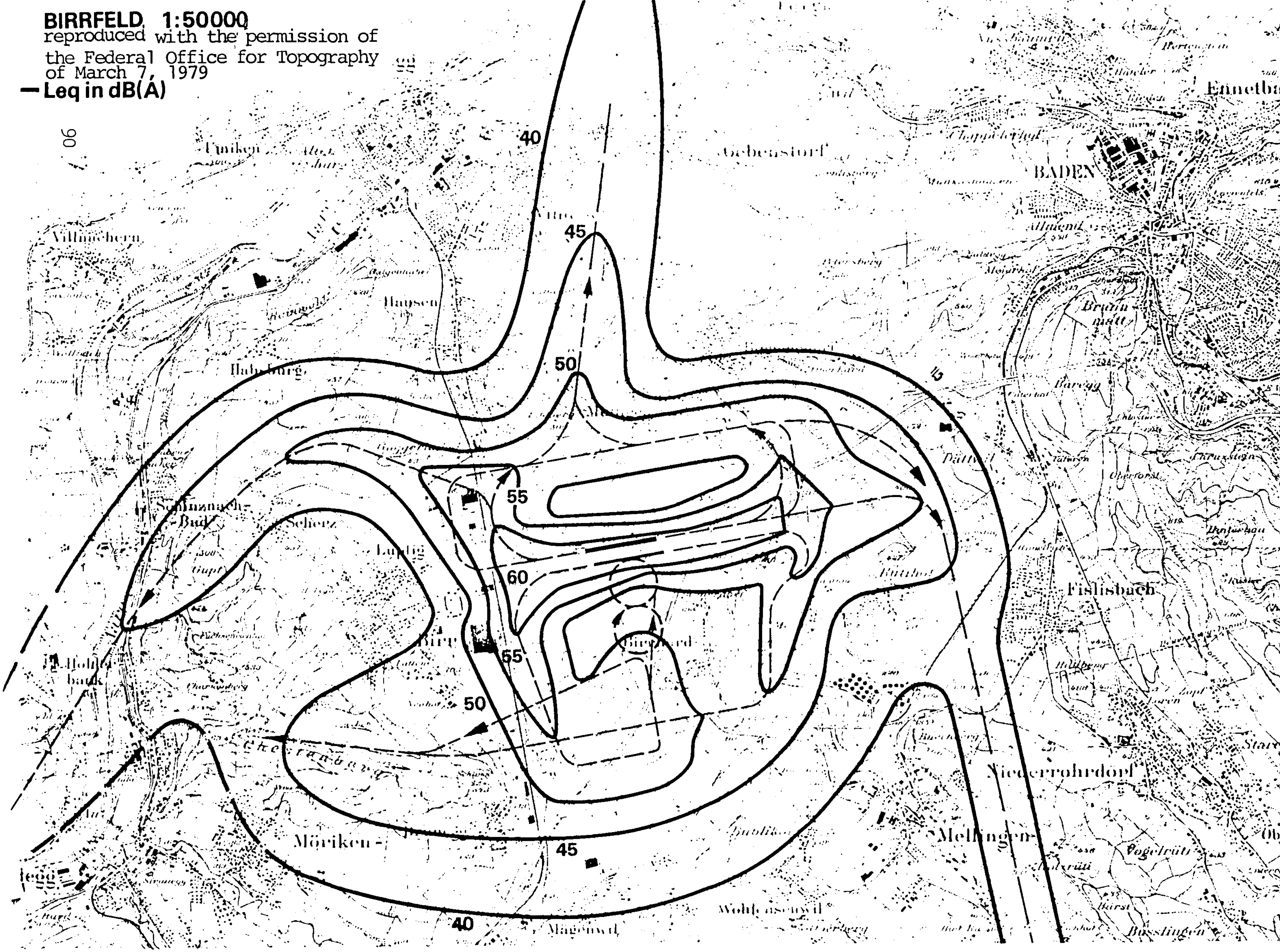
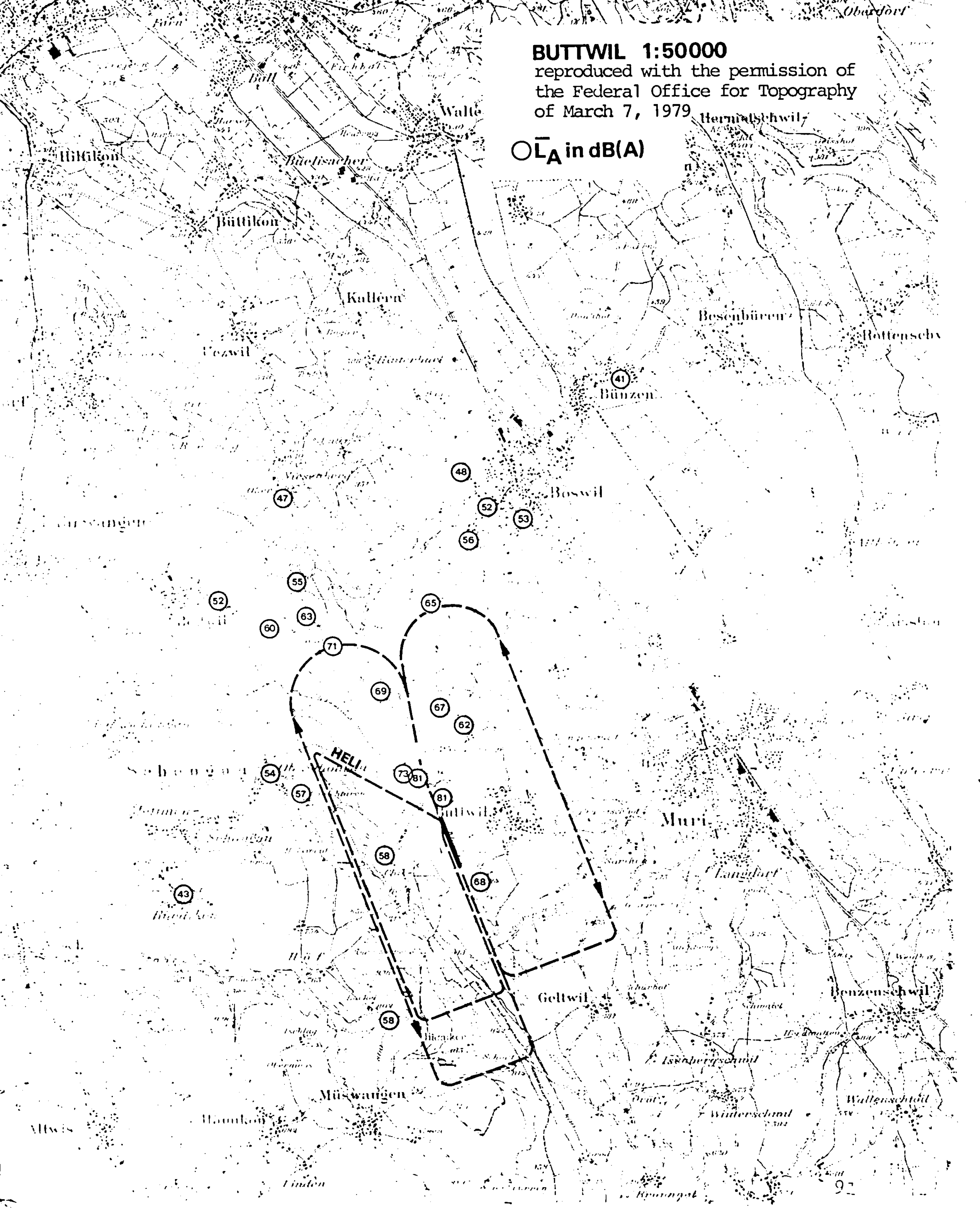
— **Leq in dB(A)**




BUTTWIL 1:50000
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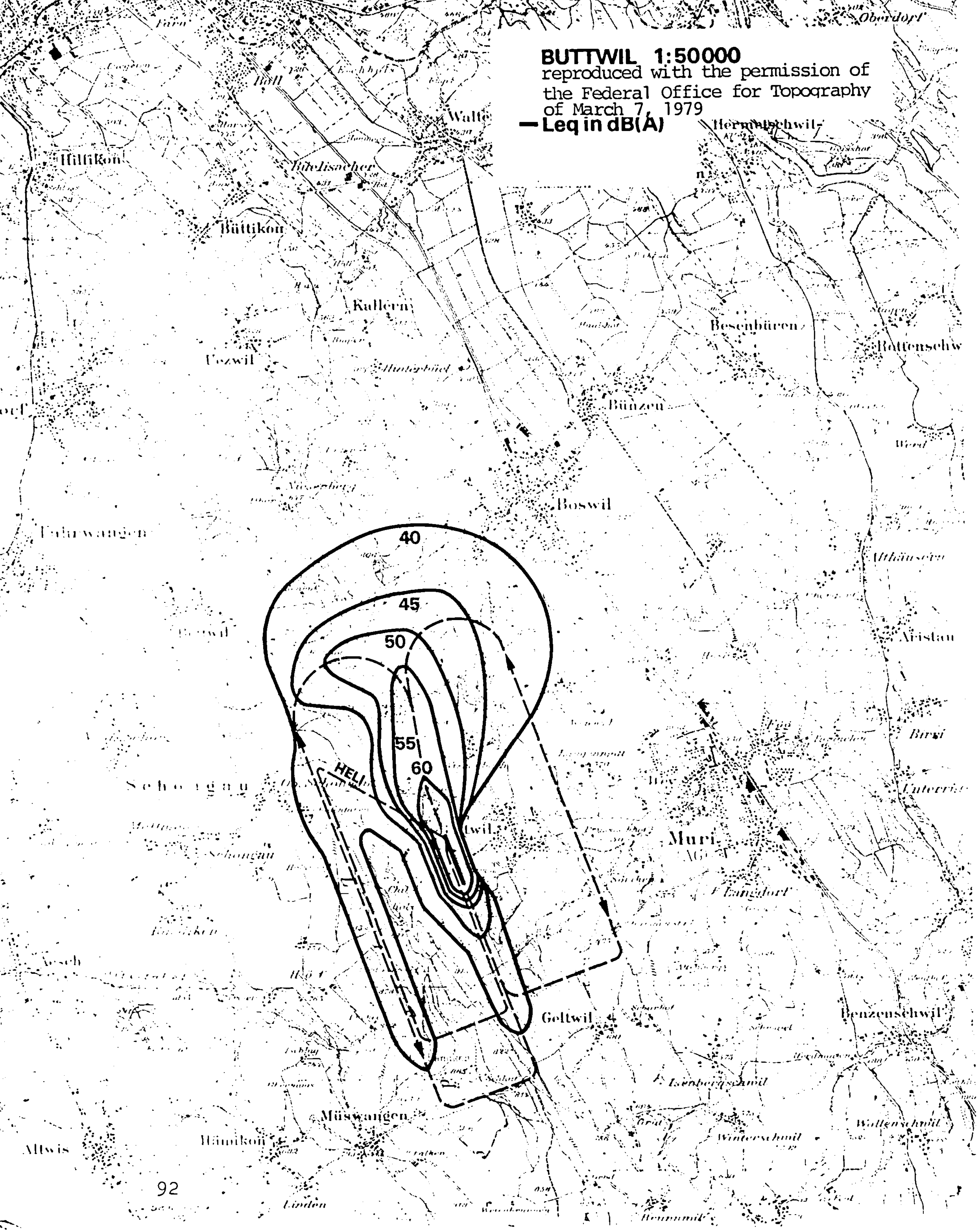
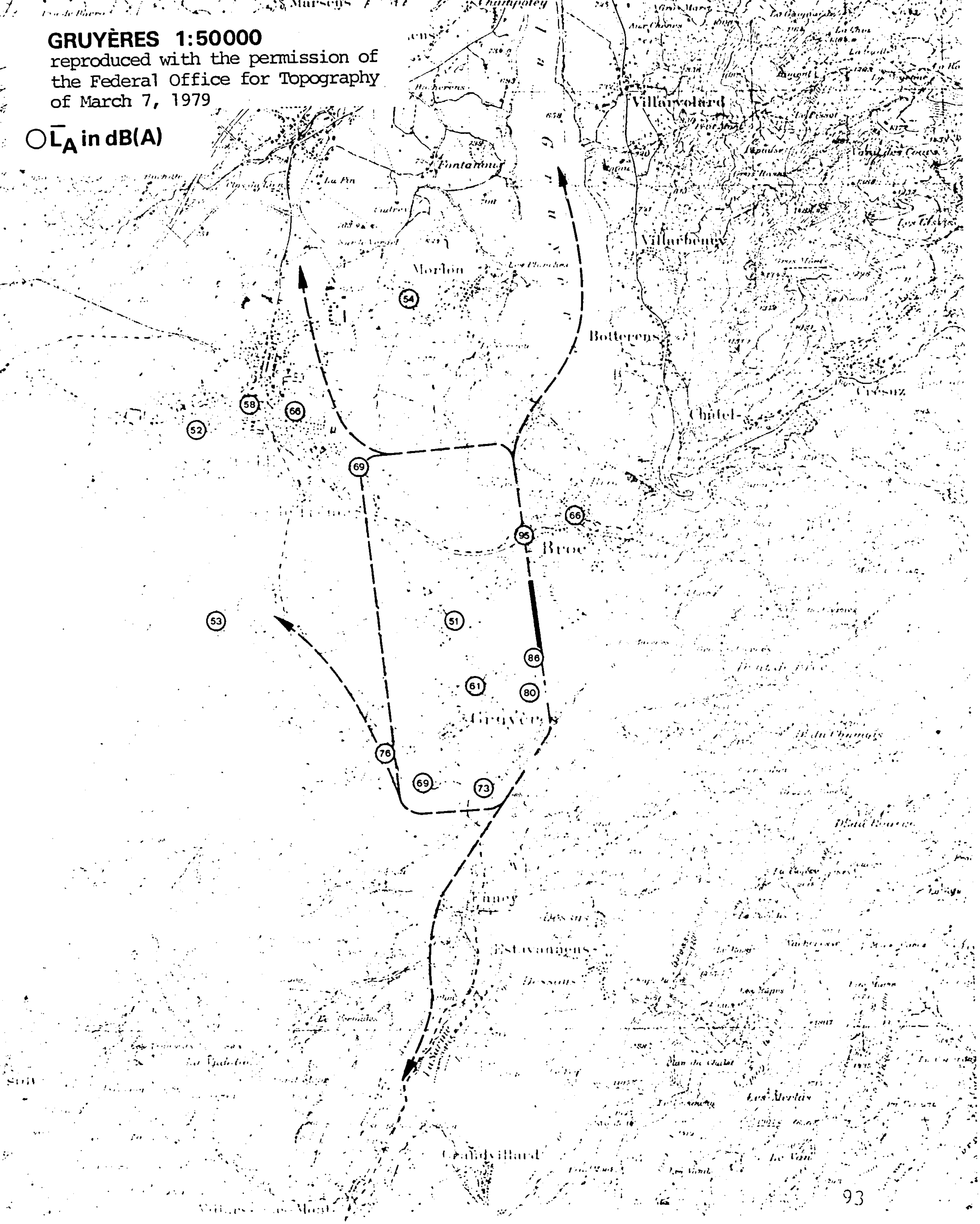
of March 7, 1979
$\bar{L}_A$ in dB(A)
HELI
41
48
47
52
53
56
55
52
63
60
65
71
69
67
62
54
73
81
81
57
58
68
43
58
Hilfikon
Büttikon
Kallern
Bünzen
Besenbüren
Boswil
Muri
Geltwil
Müswangen
Benzenschwil
Isenbergschwil
Wallenschwil
Winterschwil
Langdorf
Linden


BUTTWIL 1:50000
reproduced with the permission of the Federal Office for Topography of March 7, 1979
— Leq in dB(A)
40
45
50
55
60
HELI
Boswil
Muri
Geltwil
Müswangen
Bünzen
Besenbüren
Kallern
Büttikon
Hilfikon
Benzenschwil
Aristau


GRUYÈRES 1:50000
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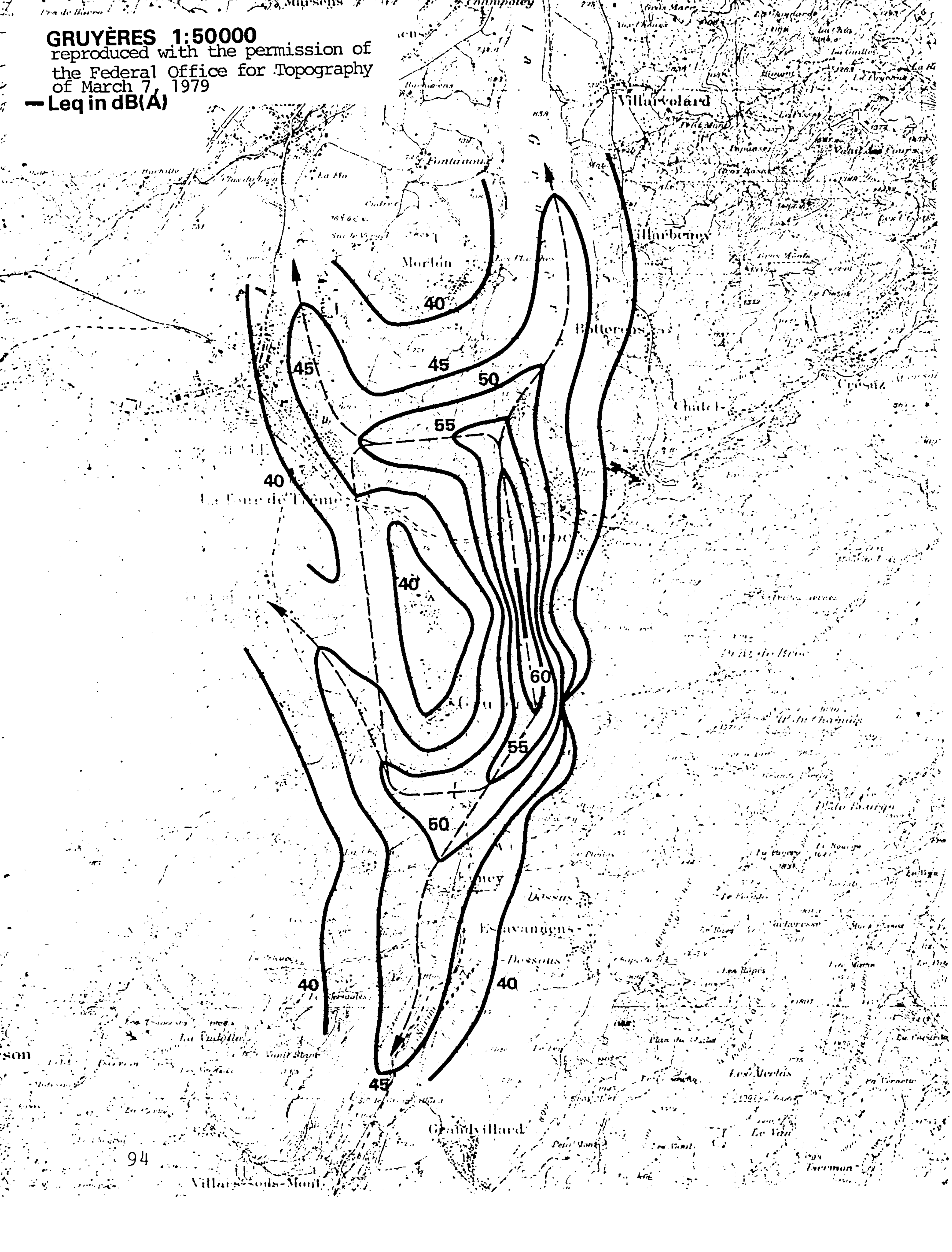
○ $\overline{L}_A$ in dB(A)
Villarvolard
Villarbeney
Morlon
Botterens
Crésuz
Broc
Gruyères
Estavannens
Grandvillard
54
58
66
52
69
66
95
51
53
86
61
80
76
69
73


GRUYÈRES 1:50000
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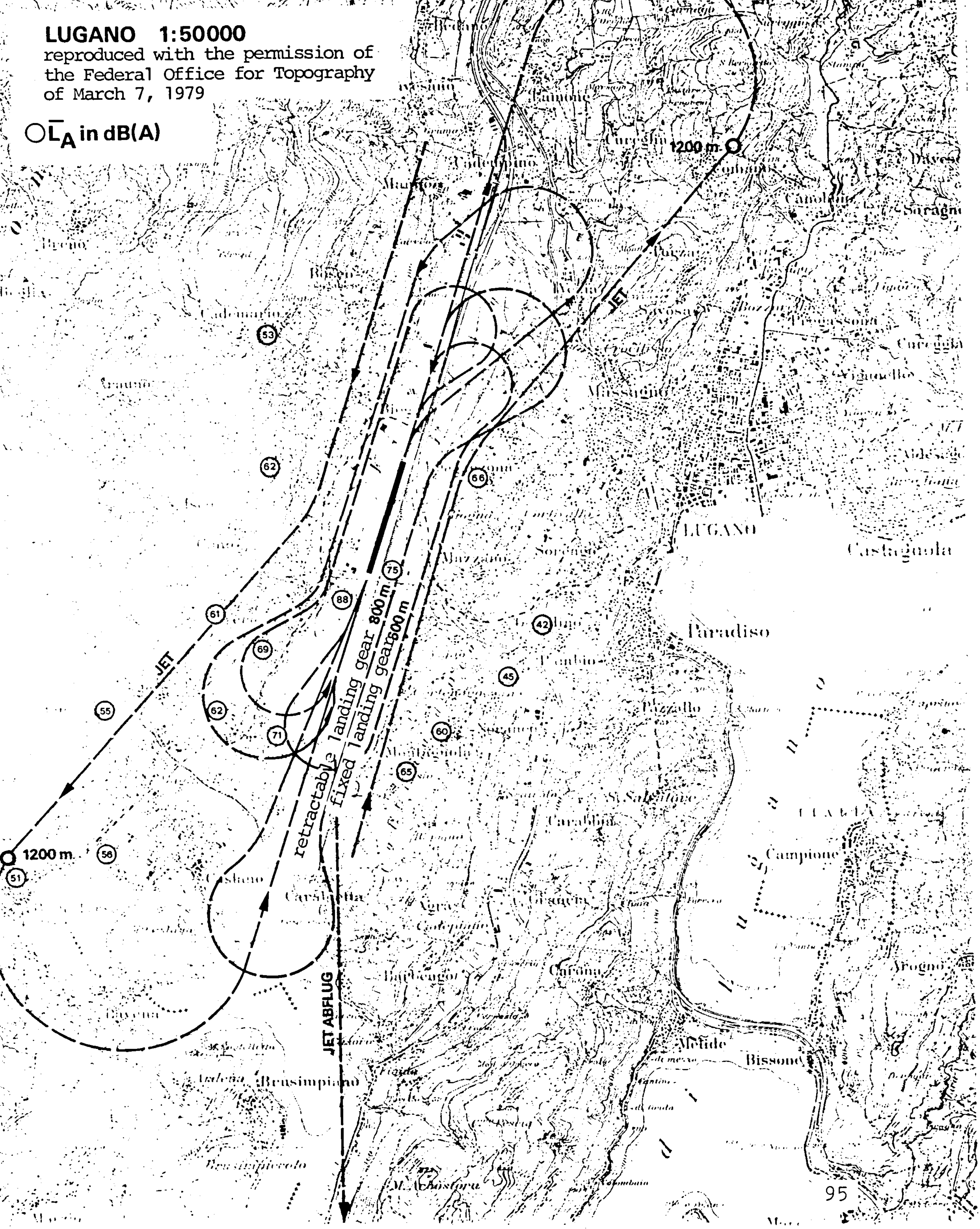
of March 7, 1979
— Leq in dB(A)
40
45
45
50
55
40
40
60
55
50
40
40
45
Morlon
Villarvolard
Grandvillard
Villars-sous-Mont


LUGANO 1:50000
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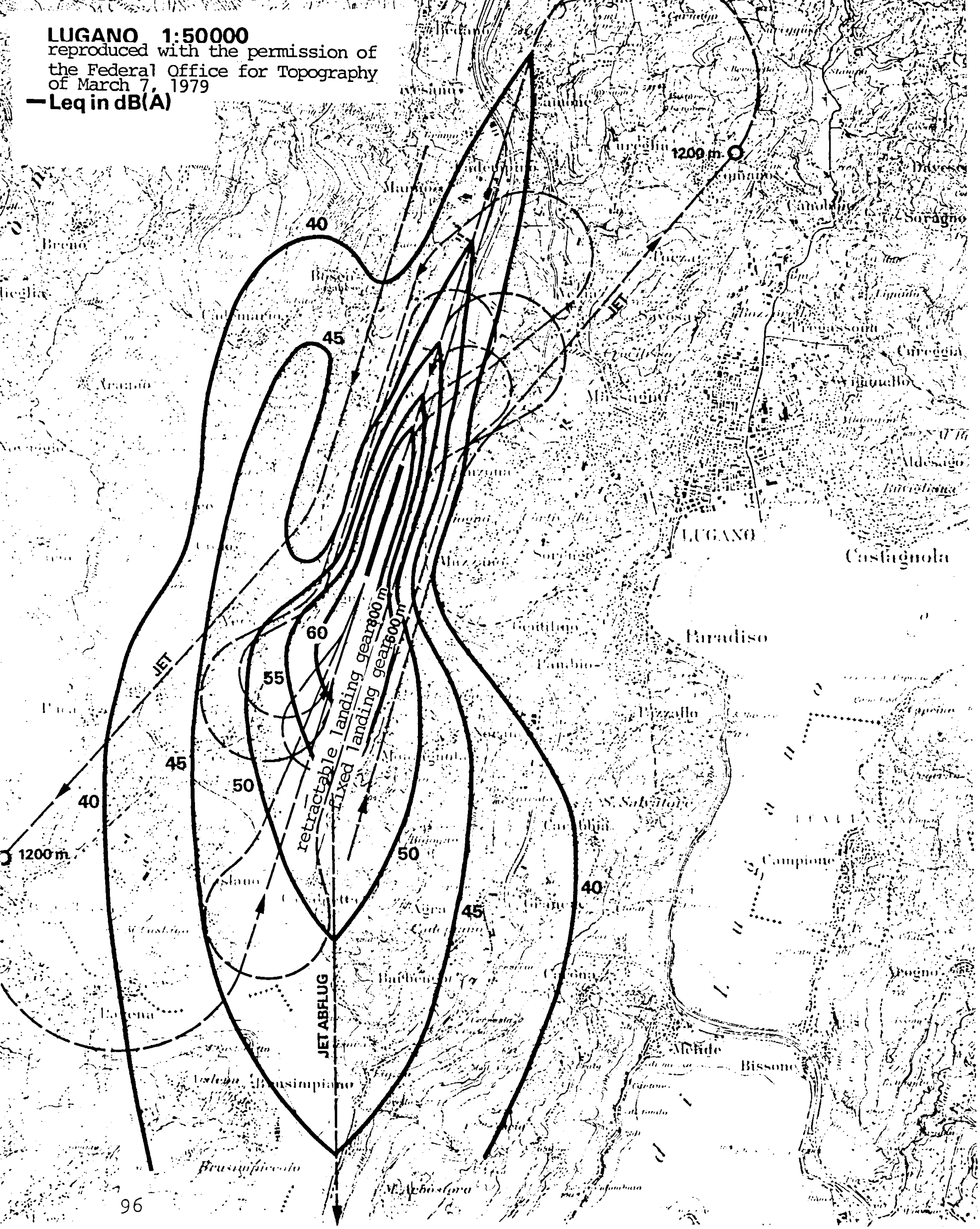
of March 7, 1979
$\bar{L}_A$ in dB(A)
1200 m
JET
1200 m
JET
retractable landing gear 800 m
fixed landing gear 600 m
JET ABFLUG
53
62
66
75
88
61
69
42
45
55
62
71
60
65
56
51
LUGANO
Castagnola
Paradiso
Massagno
Campione
Melide
Bissone
Carona
Brusimpiano


LUGANO 1:50000
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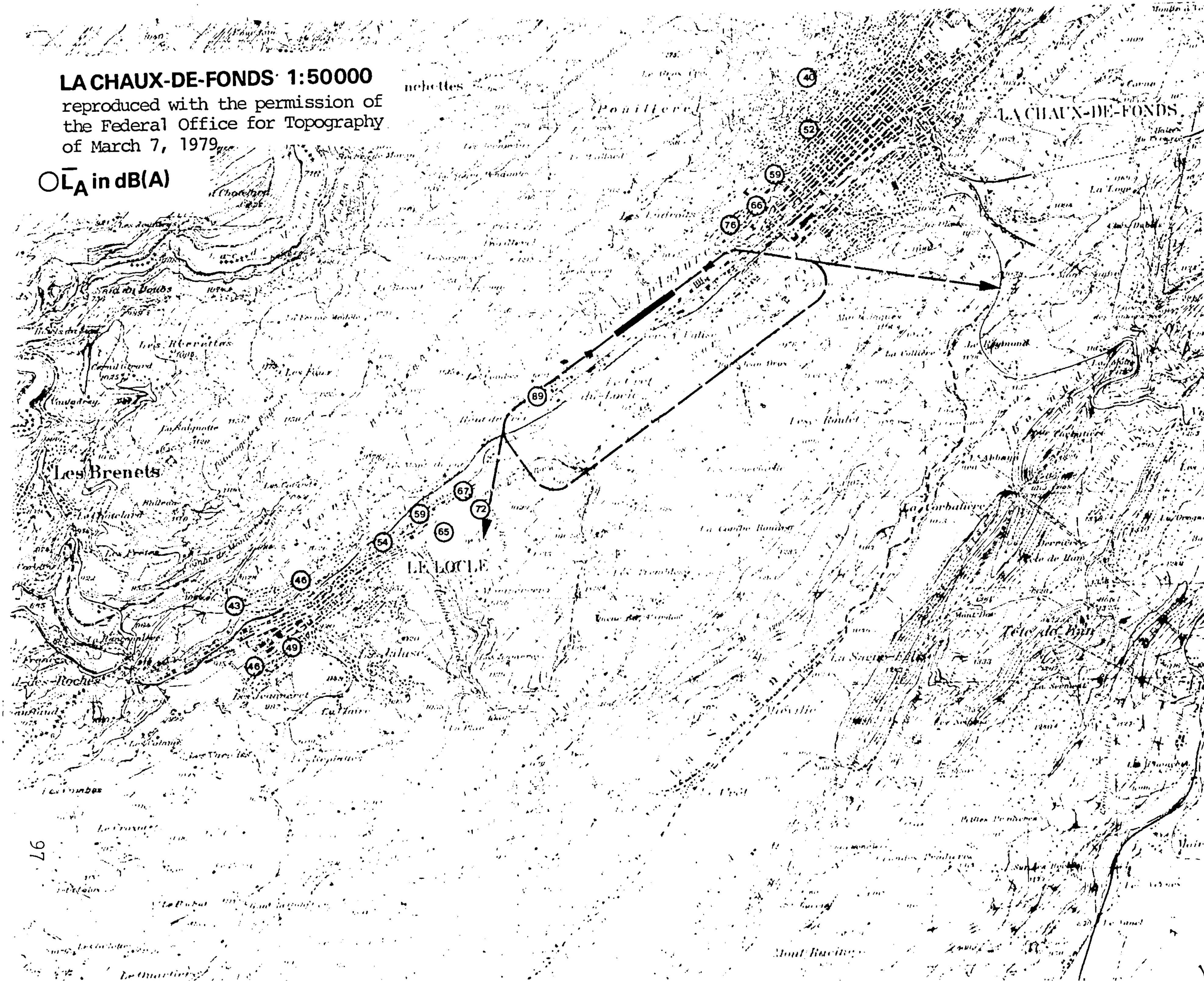
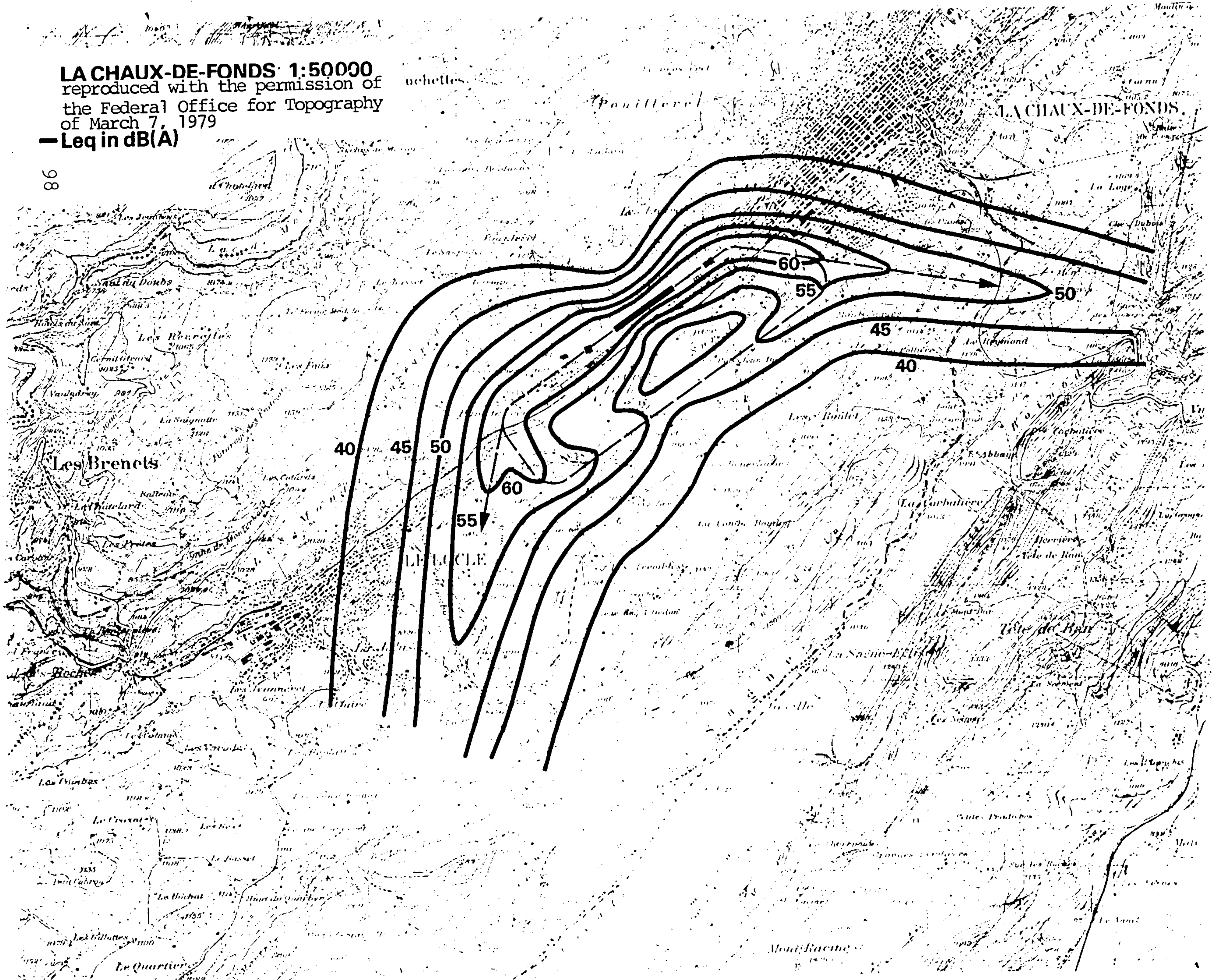
of March 7, 1979
Leq in dB(A)
1200 m
JET
JET
1200 m
40
45
50
55
60
45
40
50
45
40
800 m
600 m
retractable landing gear
fixed landing gear
JET ABFLUG
LUGANO
Castagnola
Paradiso
Massagno
Savosa
Sorengo
Agra
Melide
Bissone
Campione
Soragno
Aldesago


LA CHAUX-DE-FONDS 1:50000
reproduced with the permission of the Federal Office for Topography of March 7, 1979
○$\bar{L}_A$ in dB(A)
LA CHAUX-DE-FONDS
LE LOCLE
Les Brenets
40
52
59
66
76
89
67
72
59
65
54
46
43
49
46


LA CHAUX-DE-FONDS 1:50000
reproduced with the permission of
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of March 7, 1979
Leq in dB(A)
LA CHAUX-DE-FONDS
Les Brenets
LE LOCLE
40
45
50
55
60
60
55
50
45
40

APPENDIX II

CONTACT LETTER FOR THE SUBJECTS

This letter was given to the interrogators in order to facilitate access to the subjects.

FEDERAL OFFICE FOR ENVIRONMENTAL PROTECTION

Bern, August 1979

<u>LIVING, THE ENVIRONMENT AND TRAFFIC</u>

Dear Sir, Dear Madam:

Today's many modern problems mean that it is difficult to establish contact between authorities and the population. It is important for us to know the view of each citizen in order to be fair to everyone.

Dear Citizen, we ask you to give a warm reception to our interrogator. The inquiry which the Publitest AG is carrying out in collaboration with the IPSO Institute is done at the request of the federal authorities. We have randomly selected your address and, therefore, it would be important that you express the willingness to give personal information.

Of course, your answers will be kept secret. It will not be possible for any authority to find out your name and address. The inquiry is being used to get a representative cross-section of opinions of the inhabitants of this region.

We wish to thank you for your cooperation and remain

Very truly yours,

Federal Ministry for Environmental
Protection, The Director

Pedroli

Dr. R. Pedroli

APPENDIX III

RESULTS OF SIMPLE RESPONSE FREQUENCIES

In following we give the distribution of the responses to the individual interview questions. The questionnaire is given verbatim and interview technical remarks have been put in parentheses (jump indications, etc.).

The distributions are given in percentages. The percentage basis, that is the random sample magnitude N is given for each question. Its value vary because many questions were only directed to part of the random sample. In these cases, we give the question in parentheses and who was asked the question and who was not asked the question.

As a rule, the responses are alternating for each question. The frequencies of the various responses add up to 100%. Because of the rounding error (5 digit rounding of the second place after the digit) the percentage sums can deviate from 100% by ± 0.1%. We did not make any corrections to the error.

If several answers can be given to the same question at the same time, the individual fractions add up to more than 100%. This kind of question is indicated by the indication "multiple responses".

1.	How long have you been living in this community? N = 1424	- less than 1 year	5.9
		- 1 to 2 years	4.8
		- 2 to 5 years	11.3
		- 5 to 10 years	14.4
		- 10 to 20 years	19.2
		- more than 20 years	44.3
		- do not know/no indication	-
			100.0
2.	How long have you been living in this apartment/in this house? N = 1417	- less than 6 months	4.4
		- 6 to 12 months	5.3
		- 1 to 2 years	8.1
		- 2 to 5 years	17.5
		- 5 to 10 years	19.5
		- 10 to 20 years	20.4
		- more than 20 years	24.8
		- do not know/no indication	-
			100.0
3.	How do you like this village (village name)? N = 1424	- very well	44.6
		- well	45.7
		- moderately	7.1
		- not very well	1.8
		- not at all	0.5
		- do not know/no indication	-
			100.0
4.	(If subject has lived at location more than 5 years): How did you like it formerly: Better or not as well as today? N = 1003	- more than before	23.4
		- about the same as today	57.2
		- just about as poorly as today/I never liked it	3.6
		- less than today	15.8
		- do not know/no indication	-
			100.0
5.	Have you ever thought of moving or will you do it soon? N - 1418	- no	84.5
		- thought of this	12.4
		- would move	3.1
		- do not know/no indication	-
			100.0

6. (If moving is planned) would you move within the community or would you move away? N = 211	- will move within the community	36.0
	- will move away from the community	47.4
	- do not yet know	16.6
	- no indication	-
		100.0

7. (If moving is being considered) why are you moving? N = 214 multiple responses	- poor public transportation	4.2
	- poor shopping facilities	3.3
	- restricted possibilities for entertainment and free time	4.2
	- poor atmosphere in the village or section	4.7
	- no friends here	2.3
	- poor school conditions	1.9
	- occupational reasons	22.4
	- apartment not suitable or too expensive, etc.	30.8
	- road noise	9.8
	- train noise	1.9
	- aircraft noise	4.7
	- industrial/business noise	-
	- firing range noise	0.5
	- agricultural noise	-
	- neighbor, children noise	3.7
	- smell, gases	2.8
	- smoke, dirt	0.9
	- other reasons	44.4
	- do not know/no indication	2.8

8. (If moving not considered): You are not moving, but what would be the best reason for moving? N = 712, multiple responses	- poor public transportation	5.5
	- poor shopping facilities	3.1
	- restricted possibilities for entertainment and free time	1.8
	- poor atmosphere in the village or section	3.8
	- no friends here	1.7
	- poor school conditions	2.8

	- occupational reasons	28.8
	- apartment not suitable or too expensive, etc.	12.8
	- road noise	12.8
	- train noise	2.1
	- aircraft noise	9.1
	- industrial/business noise	1.8
	- firing range noise	1.1
	- agricultural noise	0.1
	- neighbor, children noise	2.8
	- smell, gases	3.2
	- smoke, dirt	0.6
	- other reasons	41.2
	- do not know/no indication	69.9
9. If you think of the overall community or your area, what are the 3 main advantages of living here? N = 1385, multiple responses	- good public transportation	13.0
	- good shopping possibilities	11.8
	- good possibility for free time and entertainment	3.0
	- we feel well here	27.3
	- know many people here, association colleagues	13.5
	- good school conditions	6.6
	- good playground conditions for children	4.6
	- work place (also that of a partner here)	13.6
	- I have a responsibility in the community (or my spouse does)	1.5
	- quiet situation	46.9
	- location in a green area, beautiful region	62.5
	- good air	25.3
	- no accident danger by traffic	2.1
	- near city	18.1
	- remote	7.2
	- other reasons	13.4
	- do not know/no indication	3.2

10.	what are the 3 greatest disadvantages? N = 976, multiple responses	- poor public transportation	21.9
		- poor shopping possibilities	22.8
		- poor possibilities for free time and entertainment	8.3
		- we do not feel well here	3.3
		- do not know many people here, no colleagues	4.6
		- poor school conditions	8.1
		- poor playground conditions for children	2.8
		- work place (spouse also) not here	4.2
		- I, or my spouse, do not have any function in the community	0.7
		- noise, that is, road noise	22.8
		- train noise	2.9
		- aircraft noise	19.3
		- rifle range noise	1.8
		- industrial/business noise	1.3
		- agriculture noise	0.4
		- neighbor, children noise	5.3
		- no green areas near here	0.6
		- smoke, smell, poor air	5.4
		- traffic accident danger	3.3
		- near city	0.5
		- too remote	10.3
		- other reasons	34.1
		- do not know/no indication	44.6
11.	Is the head of the household a renter or house owner? N = 1425	- subrenter	4.1
		- renter/leaser	39.6
		- owner	54.2
		- others	2.0
		- do not know/no indication	-
			100.0

12.	Number of rooms in the house. N = 1427	- 1 or 1-1/2	0.8
		- 2 or 2-1/2	7.1
		- 3 or 3-1/2	20.8
		- 4 or 4-1/2	24.7
		- 5 or 5-1/2	20.5
		- 6 or 6-1/2	12.8
		- 7 or 7-1/2	6.2
		- 8 and more	7.1
		- no indication	-
			100.0

			WITH RESPECT TO OUTSIDE NOISE	AGAINST NEIGHBOR NOISE
13.	(For single house) What is the condition of the sound insulation against noise from the outside? (If apartment or duplex or multiple unit house) what is the sound insulation in your apartment or part of the house against noise? And what are conditions for noise from neighbors?	- poorly insulated	9.9	12.9
		- rather poorly insulated	14.4	18.7
		- normal	35.6	36.5
		- rather well insulated	23.1	19.3
		- very well insulated	17.0	12.6
		- do not know/ no indication	-	-
			100.0	100.0
			N = 1430	N = 776

14.	a) composition of the household N = 1427, multiple responses	- subject lives alone	15.3
		- subject lives with the following:	
		- spouse	71.5
		- children under 16	40.3
		- children 16 and over	23.5
		- parents	9.5
		- relatives	6.2
		- other persons	2.8
		- no indication	0.1

	b) number of persons in the household N = 1427	1	14.7
		2	27.3
		3	17.0
		4	22.9
		5	11.1
		6	3.2
		7	1.8
		8/over	2.0
			100.0
15.	Marital state of subject N = 1423	- single	16.2
		- married	69.6
		- separated or divorced	3.2
		- widowed	11.0
		- no indication	-
			100.0
16.	Age of the subject N = 1422	- 16 to 20	5.3
		- 21 to 25	5.5
		- 26 to 30	8.4
		- 31 to 35	10.3
		- 36 to 40	12.7
		- 41 to 45	8.4
		- 46 to 50	7.2
		- 51 to 55	7.5
		- 56 to 60	9.3
		- 61 to 65	6.0
		- 66 to 70	7.4
		- over 70	12.0
		- no indication	-
			100.00
17.	What was the last school you attended? N = 1417	- primary school (or similar)	26.1
		- secondary school (or similar	16.3
		- trade school	35.9
		- high school	3.0
		- technical university, business school, seminar	12.8
		- university or technical high school	4.0
		- other	1.8
		- no data	-
			100.0

18. Occupational position of the subject

N = 1378

(if married)

occupation of the spouse of the subject

N = 953

ADDITIONAL OCCUPATION	SUBJECT	SPOUSE
(- housewife, houseman	43.0	35.0
(- retired person	15.1	9.7
(- invalid	0.9	1.4
- unskilled worker	9.8	7.0
- trainee	8.9	9.5
- trained worker	10.2	13.3
- laborer	1.1	2.3
- foreman	0.7	1.5
- office employee	5.3	3.0
- simple employee, official	18.7	16.8
- medium range employee or official (office chief, bank employee)	6.8	8.1
- higher level employee, official (division chief, director)	3.6	6.2
- teacher, kindergarten teacher, social worker	5.7	5.5
- farmer	7.8	8.7
- independent occupation, trade, restaurants	5.1	5.0
- retail store independent employee	2.8	2.2
- major trade independent	0.8	1.0
- businessman or manufacturer	0.9	1.9
- free trades (lawyer, doctor, artist, painter)	1.7	2.4
- still being trained	4.9	0.3
- not employed before being married	5.6	5.1
- no data	-	-
	100.0	100.0

19.	(If subject works outside of his house) Now that we are talking about your occupation, what do you think of the noise level where you work compared to at home? N = 532	- quieter	7.1
		- same level	21.6
		- same loudness	6.4
		- more noisy	54.9
		- depends	10.0
		- do not know/no indication	-
			100.0

20.	(If just as loud or noisier at the work-place) And what kind of noise is this? N - 322; multiple responses	noise from the outside:	
		- road noise	62.1
		- train noise	12.1
		- aircraft noise	7.8
		- firing range noise	3.1
		- industrial noise	14.0
		- agricultural noise	3.1
		- neighbor/children noise	6.8
		- other external noise	12.7
		noise from inside:	
		- office noise	13.0
		- machine noise (factory, shop)	30.7
		- other operating noise	21.1
		- do not know/no reading	1.2

21.	In regard to your profession, in which group do you divide your earnings (net earnings per month)? If you do not know this exactly, please give an estimate. For not employed with the spouse: Income of the spouse. For 2 income households: Both incomes together. N = 1176	- below 1000 francs	13.9
		- 1000 to 1500 francs	11.9
		- 1501 to 2000 francs	12.0
		- 2001 to 2500 francs	13.9
		- 2501 to 3000 francs	13.2
		- 3001 to 3500 francs	8.3
		- 3501 to 4000 francs	6.8
		- 4001 to 5000 francs	8.4
		- 5001 to 6000 francs	3.4
		- 6001 to 7000 francs	1.8
		- 7001 to 8000 francs	1.2
		- over 8000 francs	1.7
		- no income	3.5
		- do not know/no indication	-
			100.0

		TIME	ABSENT DURING THE WEEK
22.	During what times in the summer and during week days is the subject absent? N = 1205	05-06	3.2
		06-07	11.6
		07-08	32.2
		08-09	42.1
		09-10	46.4
		10-11	44.3
		11-12	40.2

		TIME	ABSENT DURING THE WEEK
		12-13	21.2
		13-14	31.6
		14-15	44.4
		15-16	46.9
		16-17	44.9
		17-18	34.7
		18-19	16.2
		19-20	5.5
		20-21	3.9
		21-22	3.0
		- too much variation	17.5
		- no indication	1.0

23.	As a rule, how frequently are you not at home during the entire weekend?	- never, always at home	74.8
	(Not at home = sleeping elsewhere)	- about once a month	11.5
	N - 1395	- about twice a month	5.7
		- about three times/month	3.6
		- every week	4.4
		- no indication	-
			100.0

24.	As a rule, how often are you not at home on Saturdays, that is, for more than 8 hours?	- never, always at home	72.0
	N - 1288	- about once a month	13.7
		- about twice a month	7.3
		- about three times/month	3.1
		- every week	3.8
		- no indication	-
			100.0

		TIME	ABSENT SATURDAYS
25.	(If completely absent for less than 3 Saturdays every month)	05-06	1.3
	At which times is the subject absent as a rule on Saturdays in the summer?	06-07	2.5
	N = 994	07-08	7.1
		08-09	15.2
		09-10	22.9
		10-11	23.1
		11-12	17.4
		12-13	11.4
		13-14	16.2
		14-15	25.9
		15-16	26.6
		16-17	24.7
		17-18	18.5
		18-19	12.1
		19-20	9.4
		20-21	8.2
		21-22	7.0
		- too much variation	19.2
		- no indication	1.5

26.	As a rule, how often are you not at home on Sundays, that is absent for more than 8 hours? N = 1282	- never, always at home	62.6
		- about once a month	17.9
		- about twice a month	11.5
		- about 3 times/month	4.6
		- every weekend	3.3
		- no reading	-
			100.0

27. (If completely absent on less than 3 Sundays every month)

At which times is the subject as a rule absent on Sundays in the summer?

N = 971

TIME	ABSENT ON SUNDAYS
05 - 06	2.0
06 - 07	2.6
07 - 08	4.0
08 - 09	10.3
09 - 10	16.5
10 - 11	19.3
11 - 12	18.8
12 - 13	18.9
13 - 14	27.6
14 - 15	39.1
15 - 16	40.3
16 - 17	38.1
17 - 18	30.5
18 - 19	19.3
19 - 20	10.1
20 - 21	5.6
21 - 22	3.4
- too much variation	21.1
- no indication	1.1

28.	Does it happen that you would rather spend your free time in another location than where you live? N = 1429	- no	65.2
		- yes	34.8
		- no data	-
			100.0
	(if "yes") Why? N = 474	- justification is related to noise	8.9
		- justification not related to noise	91.1
		- no indication	-
			100.0

29.	Where does the subject spend its free time in the summer for good weather? N = 1423	- in the house or apartment	13.1
		- in the garden or balcony	39.1
		- in the close vicinity	28.3
		- far away	12.1
		- depends	7.4
		- no reading	-
			100.0
30.	(If free time is spent in the surroundings or rather far away) What is the noise level compared to here? N = 565	- quieter	37.9
		- same quietness	41.4
		- same loudness	5.0
		- noisier	11.3
		- depends	4.4
		- no reading	-
			100.00
31.	(If same loudness, noisier or varies). How is that for the noise? N = 109, multiple responses	- road noise	51.4
		- train noise	5.5
		- aircraft noise	22.9
		- industrial noise	2.8
		- firing range noise	-
		- agriculture noise	2.8
		- neighbor/children noise	12.8
		- noise which is related to our own free time occupation	9.2
		- free time noise of other people	24.8
		- other noise	10.1
		- no reading	7.3

32. On this sheet you see a few properties and 2 always belong together as counterparts and this can also be seen on the same line in the diagram. Please describe your surroundings of your apartment with these property words. In each line, therefore, mark the properties which best apply to your surroundings. An example, if you believe that your surroundings is very inviting, then make an x in the left circle. If you do not believe this, then make an x on the right side. The less inviting it is, the more to the right you should go.

N = 1428; line sums = 100.0%

	1.	2.	3.	4.	5.	6.	
INVITING	○	○	○	○	○	○	NOT INVITING (EXAMPLE)
FULL OF VARIATION	22.1	29.0	21.7	13.2	8.8	5.3	MONOTONOUS
AGITATED	18.7	24.6	28.1	16.1	8.1	4.3	DEAD
WELL KNOWN	53.2	24.9	10.9	4.8	3.4	2.8	FOREIGN
DANGEROUS	4.4	4.8	7.4	8.1	27.4	47.8	SAFE
QUIET	40.0	26.2	12.0	9.2	6.2	6.4	NOISY
DOES NOT MATTER	5.9	6.8	8.9	16.6	28.1	33.7	READY TO HELP
QUIET	41.8	31.1	16.0	6.7	2.4	2.0	HECTIC
POOR SMELL	3.6	3.9	8.9	14.4	29.3	39.9	SMELLS WELL
BORING	4.8	6.5	16.4	31.1	26.2	14.9	ENTERTAINING
DIRTY	1.2	0.8	2.1	6.9	27.0	61.9	CLEAN

33.	When you think of your close environment, do you think of things that you don't like (or your family)? N = 1414	- nothing	64.4
		- yes	35.6
		- no reading	-
			100.0

34.	(If "Yes) What is it? (If you mention traffic) What don't you like about traffic? N - 502; multiple responses	- road noise	29.5
		- train noise	3.6
		- aircraft noise	29.3
		- industrial noise	3.0
		- firing range noise	3.2
		- agriculture noise	0.8
		- neighbor/children noise	7.2
		- free time noise	2.0
		- other noise	6.2
		- smell, gases	13.7
		- smoke, dirt	5.6
		- water contamination	1.6
		- buildings, building changes	14.3
		- accident danger by traffic	6.8
		- accident danger by aircraft	0.8
		- others	25.1
		- no reading	-

35.	Are there things which disturb your family so much that you do not feel well any more? N = 1425	- no	91.9
		- yes	8.1
		- no reading	-
			100.0

36.	(If "yes") What disturbs you? (If "traffic" mentioned) What disturbs you about traffic? N = 115; multiple responses	- road noise	40.0
		- train noise	6.1
		- aircraft noise	31.3
		- industrial noise	2.6
		- firing range noise	0.9
		- agriculture noise	-
		- neighbor/children noise	13.0
		- free time noise	4.3
		- other noise	8.7
		- smell, gases	16.5
		- smoke, dirt	2.6
		- water contamination	1.7
		- building, building changes	5.2
		- accident danger by traffic	3.5
		- accident danger by aircraft	-
		- others	18.3
		- no reading	-
37.	Are there things in your vicinity which could impair the health of you (or your family)? N = 1429	- no	90.8
		- yes, possibly	7.1
		- yes, certainly	2.2
		- no reading	-
			100.00
38.	(If possibly or certainly) Can you tell me what this is (if traffic mentioned) what disturbs you about traffic? N = 130; multiple responses	- road noise	27.7
		- train noise	6.2
		- aircraft noise	20.8
		- industrial noise	2.3
		- firing range noise	0.8
		- agriculture noise	0.8
		- neighbor/children noise	8.5
		- free time noise	2.3
		- other noise	4.6
		- smell, gases	39.2
		- smoke, dirt	12.3
		- water contamination	3.1
		- building, building changes	3.1
		- accident danger by traffic	4.6
		- accident danger by aircraft	-
		- others	20.8
		- no reading	1.5

39.	Are there things in your environment which would endanger your life or that of your family? N = 1425	- no - yes, possibly - yes, certainly - no reading	91.4 7.0 1.6 - 100.00
40.	(If possibly or certainly) What is it? (If "traffic" mentioned) What disturbs you about traffic? N = 120; multiple responses	- road noise - train noise - aircraft noise - industrial noise - firing range noise - agriculture noise - neighbor/children noise - free time noise - other noise - smell, gases - smoke, dirt - water contamination - building, building changes - accident danger by traffic - accident danger by aircraft - others - no reading	19.2 3.3 9.2 0.8 0.8 - 2.5 0.8 0.8 6.7 1.7 0.8 4.2 59.2 6.7 8.3 2.5
41.	Can you establish air pollution or water pollution or smells in your close vicinity? N = 1406; multiple responses	- no, nothing - air pollution - water pollution - smell - others - no reading	65.8 13.4 6.5 22.0 0.5 1.6
42.	(If "yes") What are the reasons for this contamination? N = 478; multiple responses	- motor vehicles - train - aircraft, airport - industrial - agricultural - sewage - garbage burning, garbage dumps - oil heating, remote heating plant - others - origin unknown - no reading	29.5 0.4 6.3 15.9 21.5 18.4 8.8 10.0 15.3 4.0 0.6

43. Are you bothered by this?

	AIR POLLUTION	WATER CONTAMINATION	SMELL
- very strong	19.1	24.7	19.0
- only moderate	39.4	37.1	34.0
- only slightly	31.9	27.0	37.6
- not at all	9.6	11.2	9.5
- no reading	- -	- -	- -
	100.0	100.0	100.0
	(N = 188)	(N = 89)	(N = 306)

44 a) What noises from the outside do you hear during the day in the summer? Please also mention noises which you hear very seldomly or very quietly.

N = 1429; multiple responses

b) which of these noises do you hear the most?

(N = 1382)

which noises are of second order?

(N = 1024)

which noises occur in third order?

(N = 587)

	MENTIONED	MOST FREQUENT	SECOND ORDER	THIRD ORDER
- noises from road traffic .. (trucks, autos, motorcycles, trolleys)	72.6	46.5	27.1	13.5
- noises from trains	14.5	3.6	4.8	10.1
- noises from aircraft	57.9	28.2	28.0	17.5
- noises from industry (factories)	3.8	0.9	1.7	2.7
- noises from firing range	5.3	0.4	1.9	4.6
- noises from agricultural machines	19.2	5.0	9.1	9.5
- noises from neighbors	11.2	2.7	4.7	6.0
- noises from children	19.2	4.8	8.6	10.9
- noises from free time activities	5.5	0.9	2.6	3.6
- noises from building sites	7.4	2.0	1.7	3.2
- noises of nature	17.3	2.8	5.6	12.1
- other noises	10.4	2.1	4.3	6.3
- no reading	- -	- -	- -	- -
		100.0	100.0	100.0

45.	(If "aircraft" mentioned for question 44) What kind of aircraft do you hear? N = 828; multiple responses	- helicopter	20.9
		- single motor sport aircraft	50.2
		- glider pulling aircraft	10.6
		- two-motor sport aircraft	26.3
		- small jet	17.4
		- small commercial aircraft	12.8
		- large commercial aircraft	22.1
		- military aircraft	25.6
		- others	2.5
		- subject does not distinguish	9.5
		- no reading	4.1

46. (Subject is shown a scale between 1-10)

Let us assume that this is a thermometer with which you can measure how much you are disturbed by noise at home by... (most frequent noise according to question 44).

No. 10 means that the noise disturbance is unbearable, no. 0 means that you do not hear it at all. Just mention a number which goes with this.

N = 1383

MENTIONED NUMBER	
10	3.8
9	1.8
8	6.8
7	7.0
6	6.4
5	14.0
4	10.4
3	13.9
2	14.0
1	10.1
0	11.9
	100.0

48. (If road noise has not already been classified as the most disturbing noise in question 46)

And to what extent do you feel disturbed in general by car, truck and motorcycle noise?

Please again use the thermometer (Scale 1-10).

N = 779

MENTIONED NUMBER	
10	0.6
9	0.5
8	1.0
7	3.3
6	3.3
5	6.2
4	6.8
3	9.2
2	16.2
1	15.3
0	37.5
	100.0

49. What do you believe? Do you have the feeling that you could become accustomed to noise?

N = 1266

- yes	53.2
- yes, but only temporarily	6.3
- yes, we don't have any other choice	17.9
- do not know	4.9
- no	17.7
- no reading	-
	100.0

50. (If train has not yet been mentioned in question 46 as the most disturbing noise:)

And to what extent do you feel disturbed by train noise?

Please again mention the number (scale 1-10)

N = 1339

MENTION NUMBER	
10	- -
9	0.1
8	- -
7	0.4
6	0.3
5	0.6
4	0.4
3	1.6
2	4.2
1	9.3
0	83.2
	100.0

51. (If aircraft noise has already not been classified in question 46 as the most disturbing noise:)

And by aircraft noise, how much are you disturbed?

Please again mention the number (scale 1-10)

N = 1026

MENTION NUMBER	
10	1.0
9	0.9
8	1.7
7	2.4
6	2.0
5	5.3
4	6.0
3	7.8
2	18.0
1	18.9
0	36.0
	100.0

47./52. (If aircraft noise was classified in question 46 as the most disturbing noise or if the evaluation of the aircraft noise in question 51 achieves a scale value of 3 or more)

a) Which kind of aircraft do you hear most intensely?

N = 668; multiple responses

- helicopter	13.5
- single motor sport aircraft	28.0
- glider pulling aircraft	8.2
- two-motor sport aircraft	15.4
- small jet	15.9
- small commercial aircraft	3.9
- large commercial aircraft	13.6
- military aircraft	22.8
- others	2.7
- no difference	7.9
- none are particularly disturbing	6.3
- no data	4.0

b) (if in a) more than one response:)

And which of them disturb you the most?

N = 212

- helicopter	11.8
- single motor sport aircraft	19.3
- glider pulling aircraft	10.8
- two-motor sport aircraft	14.2
- small jet	14.6
- small commercial aircraft	0.9
- large commercial aircraft	8.0
- military aircraft	18.4
- others	1.9
- no data	-
	100.0

53. Over the year, how frequency has the following happened to you?

	DAILY	SEVERAL TIMES A WEEK	EVERY WEEK	1 - 2 TIMES A MONTH	RATHER RARE	NEVER	NO READ-ING
a) You are scared by aircraft noise?	1.3	2.4	3.6	9.4	16.9	66.4	--
b) Because of aircraft you closed the window or never opened it?	1.5	2.4	2.5	2.7	6.9	84.1	--
c) you were never able to rest properly?	1.0	1.5	3.6	2.6	8.0	83.3	--
d) That you withdrew to your house because of aircraft noise?	0.6	0.9	1.4	1.8	4.1	91.2	--
e) that you were mad because pf aircraft noise?	3.6	4.7	4.6	6.9	12.3	68.0	--

N = 1425; line sums = 100.0%

54.	How many aircraft do you believe fly near here every day? During this time of the year (summer)? N = 1430	- no aircraft in the vicinity	28.3
		- aircraft come close to here less than once a day	15.0
	COLLECTION OF AN INTERVAL SCALE	- 1 - 5	12.3
		- 6 - 10	13.9
		- 11 - 20	11.4
		- 21 - 30	7.5
		- 31 - 50	6.3
		- 51 - 100	3.2
		- 101 - 200	1.2
		- 201 and more	0.9
		- no reading	-
			100.0

55.	(If aircraft pass over daily) Are these aircraft which come from the airport... (substitute name)? N = 806	- yes, almost all	50.0
		- yes, I believe so	11.9
		- only partially	26.3
		- do not know	2.0
		- no	9.8
		- no reading	-
			100.0

56.	(If aircraft are in the vicinity) And at which distance do aircraft usually pass, what do you estimate? N = 1003	- below 150 m	13.6
		- 151 to 250 m	15.4
		- 251 to 400 m	15.9
		- 401 to 600 m	13.2
		- 601 to 800 m	6.7
		- 801 to 1200 m	11.3
		- 1201 to 1600 m	6.1
		- 1601 to 2000 m	5.5
		- more than 2000 m	12.4
		- no data	-
			100.00

If the aircraft noise disturbance according to questions 46 or 51 is 2 or less, go to question 62

Questions 57-61 are only posed if aircraft noise disturbance achieves a scale value of 3 or more.

57.	During which time of the year do aircraft bother you the most? N = 539; multiple responses	- spring	15.6
		- summer	84.7
		- fall	13.0
		- winter	1.1
		- all the same	9.3
		- no reading	4.8
			100.0

58. And during what days of the week?

N - 524

- Saturday	3.2
- Sunday	13.4
- Saturday and Sunday	42.4
- week days	12.4
- always the same	21.4
- depends on the weather	7.3
- no reading	-
	100.0

59. During which parts of the day are you bothered most by aircraft?

N = 538; multiple responses

TIME	
05 - 06	3.6
06 - 07	3.6
07 - 08	9.0
08 - 09	18.2
09 - 10	27.1
10 - 11	33.4
11 - 12	40.9
12 - 13	48.4
13 - 14	60.0
14 - 15	67.6
15 - 16	64.6
16 - 17	59.3
17 - 18	48.9
18 - 19	32.7
19 - 20	21.8
20 - 21	9.9
21 - 22	7.3
- always the same	6.7
- too much difference	12.6
- depends on weather	3.9
- no reading	-
	100.00

60. Think about the last few months, how often does the following happen?

	DAILY	SEVERAL TIMES A WEEK	WEEKLY	1-2 TIMES A MONTH	RARE	NEVER	NO READING
a) ...that at home, you were not able to understand everything because of aircraft noise while on the telephone or while listening to the radio or television?	4.9	6.0	8.5	7.6	20.4	52.7	--

b)...you were awakened by aircraft noise?	0.5	2.4	3.6	4.7	16.5	72.3	--
c)...your house vibrated because of aircraft?	1.5	2.2	3.8	10.2	19.5	62.8	

N = 554; line sums 100.0%

61. Let us speak about noise: how is your hearing?

N = 554

- good, normal	86.6
- not so good any more	11.4
- poor	2.0
- no reading	-
	100.0

Questions 62 and 63 are only posed if aircraft noise disturbances according to questions 46 or 51 achieve a scale value of 2 or less.

62. Think about the last few months, how often does it happen that the following occurs?

	DAILY	SEVERAL TIMES WEEKLY	WEEKLY	1-2 TIMES/ MONTH	RARE	NEVER	NO READING
a)...because of street noise, at home you were not able to understand everything on the telephone, the radio or television?	3.5	3.6	3.2	3.1	10.2	76.4	--
b)...you were woken from your sleep by street noise?	2.7	4.0	4.4	4.1	13.3	71.5	--
c)...your house shook because of street noise?	0.9	1.5	0.7	1.9	6.6	88.3	--
d)...you closed windows or didn't open them because of street noise?	4.4	4.9	2.7	2.4	7.1	78.6	--
e)...you were not able to rest properly at home?	0.9	2.7	2.3	2.5	9.6	82.0	--
f)...you were mad about street noise?	2.0	3.9	4.0	3.3	10.9	75.9	--

N = 850; line sums = 100.0%

63.	Let us speak about noise: how is your hearing? N = 826	- good, normal	88.4
		- not so good any more	9.6
		- poor	2.0
		- no reading	--
			100.0
64.	What do you think: In the next 10 years will you have to deal with aircraft noise or will it decrease? N = 1203	- much more	8.1
		- probably more	56.1
		- about the same	28.6
		- probably less	6.7
		- much less	0.4
		- do not know/no reading	--
			100.0
65.	In which rooms do you best hear aircraft noise? N = 1368; multiple responses	- living room	28.5
		- bedroom	22.7
		- children's room	5.2
		- other rooms (work room, dining room)	6.3
		- kitchen	8.1
		- bathroom	1.2
		- the same everywhere	33.0
		- no aircraft noise	19.0
		- no data	-
66.	(If aircraft noise audible) In which rooms does aircraft noise bother you the most? N = 1098; multiple responses	- living room	25.7
		- bedroom	17.8
		- children's room	3.4
		- other rooms (work room, dining room)	5.3
		- kitchen	5.7
		- bathroom	0.2
		- the same everywhere	15.5
		- no disturbance	36.6
		- no reading	--
67.	And road noise, in which rooms do you hear the noise the most? N = 1389; multiple responses	- living room	32.0
		-bedroom	33.2
		- children's room	8.7
		- other rooms (work room, dining room)	8.6
		- kitchen	15.9
		- bathroom	2.0
		- the same everywhere	14.3
		- no road noise	21.2
		- no reading	--

68.	(If road noises audible) In which rooms does road noise bother you the most? N = 1088; multiple responses	- living room	29.2
		- bedroom	32.2
		- children's room	7.5
		- other rooms (work room, dining room)	6.8
		- kitchen	11.0
		- bathroom	1.1
		- the same everywhere	8.9
		- no disturbance	25.5
		- no reading	--
69.	Is there a balcony or a garden? N = 1422	- nothing available	6.7
		- balcony available	22.5
		- garden available	29.5
		- both available	41.4
		- no data	-
			100.0

			DIRECTLY EXPOSED	SOMEWHAT PROTECTED
70.	Are balconies and/or gardens directly exposed to street noise or aircraft noise or protected from them? Balcony: N = 908; Garden: N = 1007; line sums: = 100.0%	Road Noise		
		- balcony	49.9	50.1
		- garden	44.2	55.8
		aircraft noise		
		- balcony	74.2	25.8
		- garden	77.7	22.3

71.	Would you spend more time on the balcony or in the garden if there were less aircraft noise? N = 1254	- yes	7.3
		- probably	2.6
		- no	90.0
		- do not know/no reading	-
			100.0
72.	Have you ever acted against the operation of aircraft or the airports? N = 1418	- yes	9.4
		- no	90.6
		- do not know/no reading	-
			100.0
73.	(If "yes") What did you do? N - 132; multiple responses	- wrote to a newspaper	4.5
		- complained with the airport	16.8
		- called or wrote an official	13.7
		- joined a protective association	7.6
		- participated in a demonstration	0.8

		- signed a petition	75.6
		- collaborated in a working group	6.9
		- others	2.3
		- no data	1.5
74.	(If "no" for question 72) Why not? N = 1296; multiple responses	- doesn't bother me	78.7
		- no time	1.3
		- doesn't do anything anyway	7.6
		- others did something	2.2
		- do not know how to do this	1.3
		- didn't dare	1.0
		- I'm too lazy	1.1
		- others	4.8
		- no data	3.6
75.	Do you ever believe you will do something about aircraft operations on the airport? N = 1394	- yes	20.6
		- no	79.4
		- do not know/no reading	-
			100.0
76.	(If "yes") What would you do most likely? N = 287; multiple responses	- wrote to a newspaper	7.6
		- complained with the airport	13.9
		- called or wrote an official	20.6
		- joined a protective association	21.2
		- participated in a demonstration	7.0
		- signed a petition	63.7
		- collaborated in a working group	19.2
		- others	2.1
		- no data	2.1
77.	Personally, do you believe that people who feel the airport the most should be paid something because of the noise level? N = 1348	- support this	13.2
		- I could imagine this	10.6
		- do not know	15.9
		- I don't believe this	22.7
		- would be opposed to it	37.6
		- no reading	-
			100.0

78. Personally, do you believe that houses which are most exposed to aircraft noise should be insulated at the cost of the state or the aircraft owner?

N = 1340

- support this	36.3
- I could imagine this	20.4
- do not know	9.7
- I don't believe this	14.8
- would be opposed to it	18.7
- no reading	-
	100.0

79. (If response to 78 is to be explained)

Who should pay for this?

N = 512

- only at the cost of the state	15.6
- not at the cost of the aircraft owner	18.8
- at the cost of both	30.7
- only at the cost of the aircraft owner	28.7
- not at the cost of the state	6.3
	100.0

80. Are you afraid of the following:

a) an accident if you cross the street on foot?

- yes	36.5
- no	63.5
- no data	-
	100.0

b) an accident when you drive in your car?

- yes	38.9
- no	50.4
- never drive	10.7
- no reading	-
	100.0

c) that an aircraft could crash on your house or kill you?

N = 1426

- yes	12.6
- no	87.4
- no reading	-
	100.0

81. a) Aircraft which depart from the airport (substitute name) don't all do the same thing. Can you tell me what they all do?

N = 1429; multiple responses

b) (For all of the mentioned type of flights):

Do you find such flights meaningful, not very meaningful, a necessary evil or superfluous?

Line sums = 100.0%

	a)	b)					
	IS DONE	MEAN-INGFUL	NOT VERY MEANING-FUL	NECESSARY EVIL	SUPER-FLUOUS	DO NOT KNOW/ NO DATA	
training flights	27.9	59.0	9.7	24.8	6.5	- -	(N = 383)
hauling flights for gliders	30.5	46.3	16.8	25.6	11.2	- -	(N = 410)
flights for paratroopers	6.5	62.1	21.8	11.5	4.6	- -	(N = 87)
private sport flights and pleasure flights	67.6	49.5	19.7	16.9	14.0	- -	(N = 910)
business flights	17.8	70.0	6.8	15.6	7.6	- -	(N = 250)
taxi flights	12.0	70.3	12.1	9.1	8.5	- -	(N = 165)
military flights	8.7	38.7	14.3	35.3	11.8	- -	(N = 119)
regular scheduled flights	18.8	67.4	7.7	16.9	8.0	- -	(N = 261)
rescue flights	20.6	96.2	0.7	2.7	0.3	- -	(N = 292)
- others	7.9	50.0	12.0	13.9	24.1	- -	(N = 108)
- do not know/no data	21.2						

82.	Have you or a family member ever flown? N = 1429	- I myself	38.6
		- one family member	11.0
		- both	23.0
		- no	27.4
		- no data	-
			100.0
83.	(If subject or family member has flown) a) during what occasions? N = 1038; multiple responses	- trip to a vacation	65.8
		- business trip	15.7
		- pleasure flight	39.8
		- rescue flight	0.4
		- fly myself	1.9
		- others	2.4
	(If subject or family member has already had a pleasure flight) b) did you or this person start from the airport (substitute name)? N = 392	- yes	62.8
		- no	37.2
		- no reading	-
			100.0
84.	Do you or a family member have contact with people which travel to the airport (substitute name) either professionally or privately, or do you have anything to do with flying or aircraft? N = 1423	- no, never	74.5
		- yes, but rarely	7.9
		- yes, sometimes	8.9
		- yes, quite regularly	5.0
		- yes, frequently	3.7
		- no data	-
			100.0

INTERVIEW PROTOCOL

I. Sex of the subject? N = 1429	- male	39.6
	- female	60.4
		100.0
II. Type of house? N = 1429	- rented house with more than 6 apartments	20.0
	- rented house with 3 to 6 apartments	17.7
	- two-family house or row house	18.8
	- single family house	36.1
	- farmhouse	7.3
		100.0
III. (If rented house) Floor? N = 539	- ground floor	19.1
	- second or third floor	42.9
	- fourth or fifth floor	29.5
	- sixth or seventh floor	6.9
	- eight floor and above	1.7
		100.0
IV. Surroundings? N = 1429	- city (center)	3.1
	- city (suburbs)	
	- large urban area	18.1
	- garden area (single family area	16.4
	- small town	8.7
	- village	
	- industrial	10.2
	- agricultural	32.1
	- outside of a village (single house, single farm)	11.3
		100.0
V. Interview situation:		
a) the subject was one of the following:	- very cooperative	70.9
	- rather cooperative	23.3
	- not very cooperative	5.5
	- not cooperative at all	0.3
		100.0
b) overall, the interview was N = 1429	- very agreeable	
	- very agreeable	70.3
	- rather agreeable	25.7
	- rather disagreeable	3.5
	- very disagreeable	0.5
		100.0

VI. Noise situation:

a) During the interview, did you have to speak louder than usual because of noise?

N = 1429

- yes	9.7
- no	90.3
	100.0

b) Do you believe that the residence of the subject is...

N = 1429

- very noisy	3.9
- rather noisy	10.8
- moderate	20.2
- rather quiet	38.3
- very quiet	26.7
	100.0

c) During the interview, did you establish special noise sources? How great was the noise?

N = 1429; line sum = 100.0%

	ESTABLISH NOTHING	WEAK	MODERATE	STRONG
- road noise in general	44.8	32.1	16.7	6.4
- noise from trucks	74.5	12.2	8.4	4.9
- train noise	89.4	6.7	2.4	1.5
- aircraft noise	56.5	23.8	14.8	4.9
- industrial noise	94.8	3.8	1.2	0.2
- construction noise	92.6	4.1	2.4	1.0
- agricultural noise	87.3	7.3	4.9	0.6
- firing range noise	99.5	0.3	0.2	- -
- neighbors and children noise	82.2	11.3	5.3	1.1
- free time noise	95.7	3.0	1.0	0.3

VII. Evaluation of the hearing of the subject?

(Indications of reduced hearing: Hearing with slightly turned head, frequent and often unnoticed approach of the head during hearing)	- normal	89.8
	- do not know	2.7
	- reduced	7.4
		100.0

N = 1427